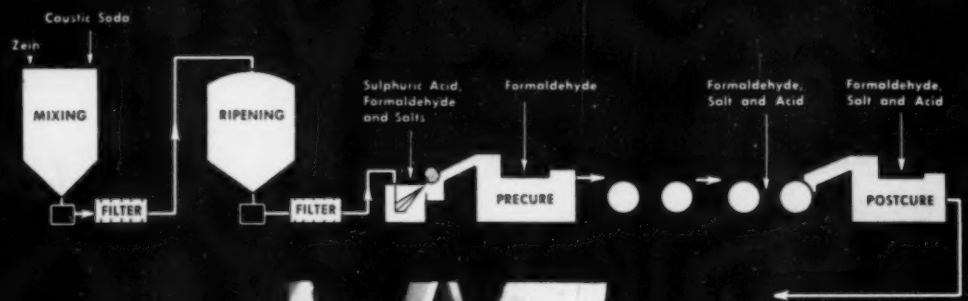
APRIL
1952

Chemical Engineering



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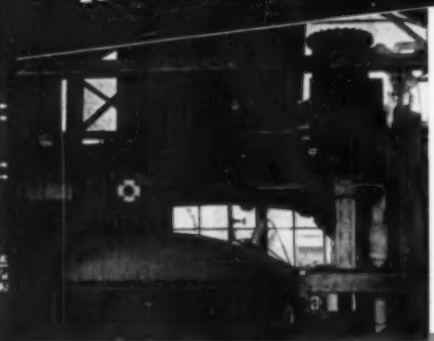
How Crystallization Procedures Have Been Improved

by Swenson



Above is the upper portion of a crystallizer showing booster, condenser, and 2-stage ejector. Below is the lower portion showing the level gauge, thermometer, and agitating mechanism.

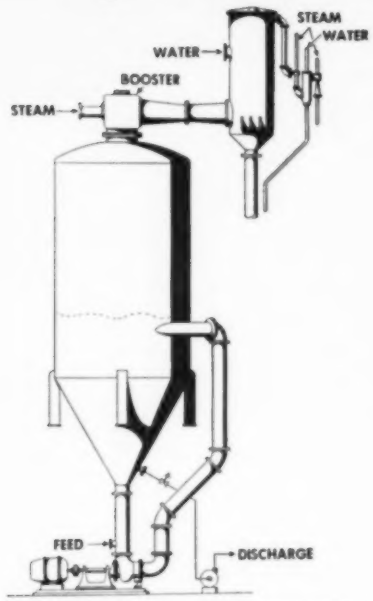
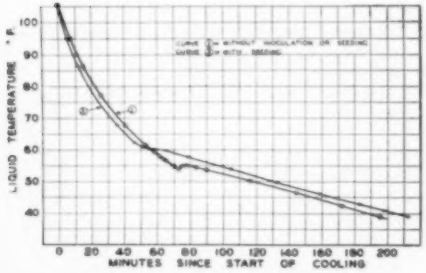
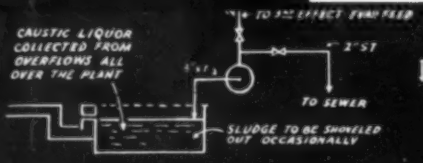
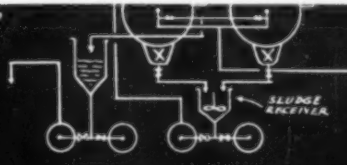


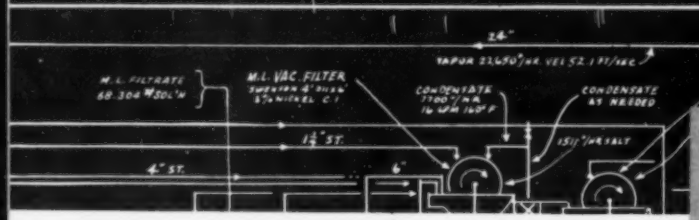
Diagram of single-stage continuous vacuum crystallizer with booster.



Typical curves for batch cooling with Swenson Vacuum Crystallizer







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- Magnesium Chloride
- Magnesium Sulfate
- Manganese Sulfate
- Potash Alum
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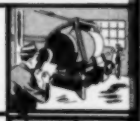
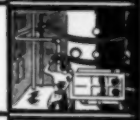
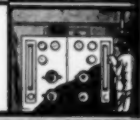
1 Analysis of Requirements	
2 Design and Layout	
3 Manufacture of Equipment	
4 Test Operation	
5 Periodic Check-Ups	

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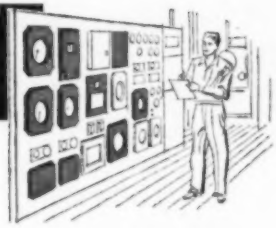

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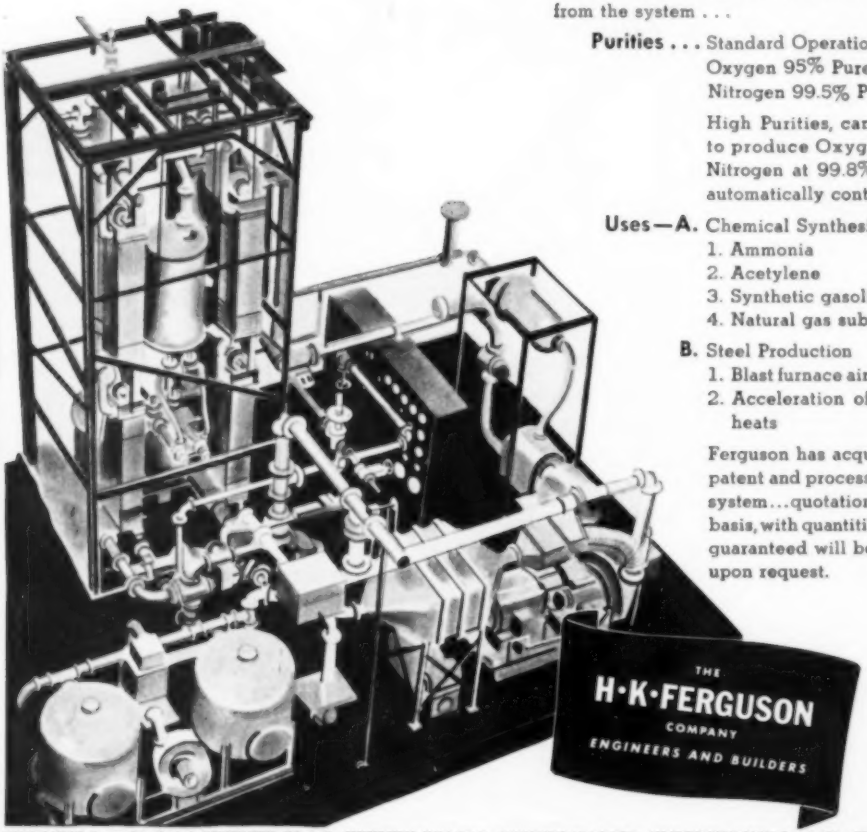

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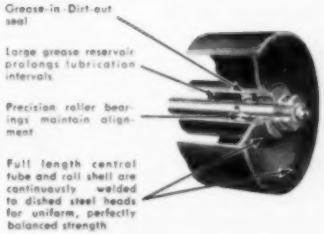
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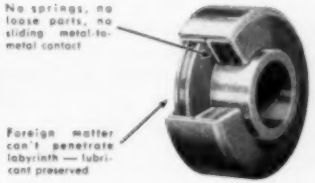
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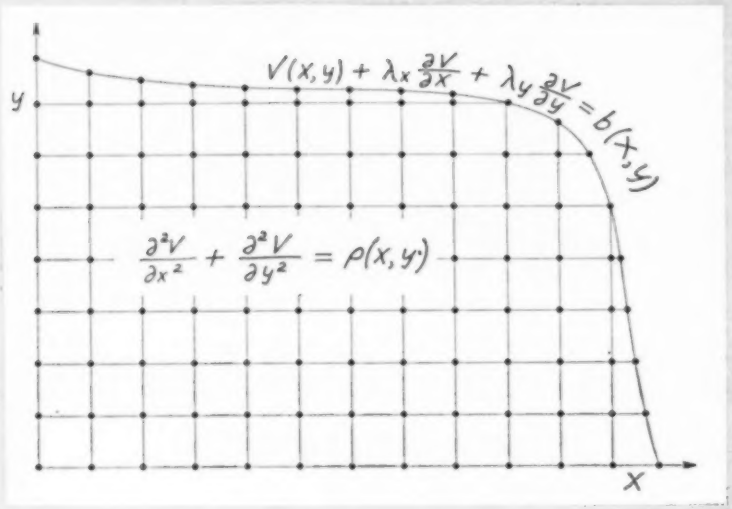
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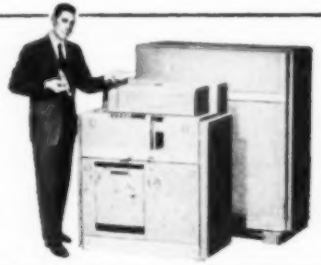

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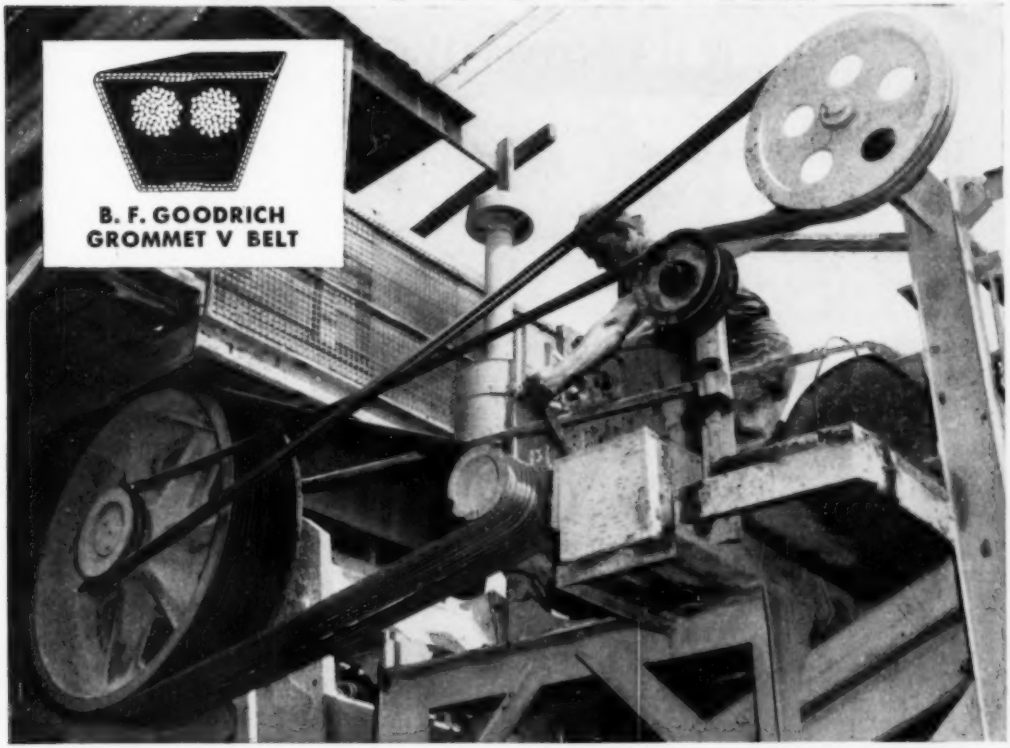

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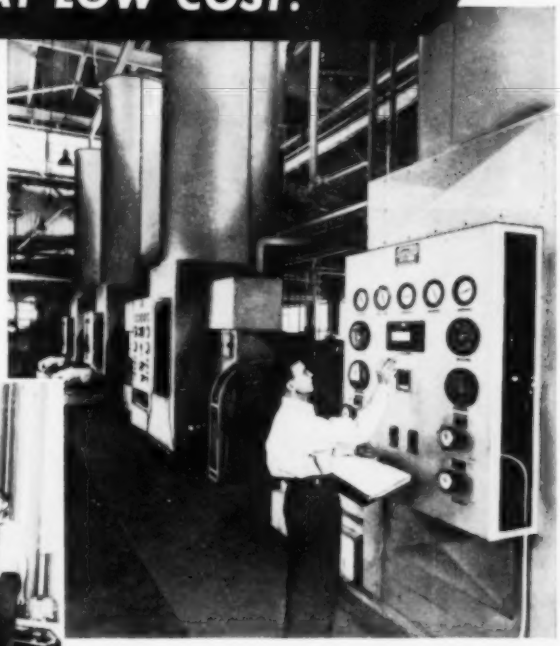
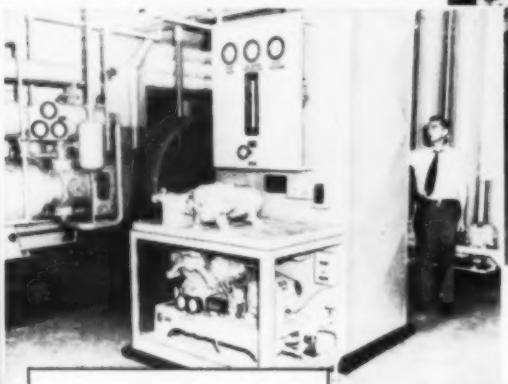
If so, it will pay you to install an Air Products Generator and make your own. Numerous models are available with oxygen capacities from 200 cubic feet to 500,000 cubic feet per hour. *All of them have been proven by the acid test of operation in industry.*





ABOVE: Air Products Oxygen Generators in customer's plant. Capacity, 25,000,000 cubic feet per month.

LEFT: R-Series Air Products Oxygen Generator in customer's plant. Capacity, 500,000 cubic feet per month.

A Partial List of Users

American Chain & Cable Co., Inc.
Bethlehem Steel Co.
Thomas A. Edison, Inc.
Ford Motor Company
Granite City Steel Co.
Grede Foundries, Inc.
Hartford Hospital
Libby-Owens-Ford Glass Co.
Pettibone Mulliken Corp.
Pittsburgh Steel Foundry Corp.
Ross-Meehan Foundries
U. S. Armed Services

Noted for economy, dependability, and ease of operation, Air Products Generators employ the most advanced cycles, according to individual requirements.

Air Products, Incorporated, is a pioneer in the design and manufacture of oxygen-nitrogen generators and related equipment. A thoroughly experienced organization of over 500 people is occupied exclusively in this work. The overall background of Air Products in this field is unmatched by any other concern.

Air Products Generators have been in constant use for many years in the plants of nationally known companies. Some of these are listed at left. Air Products has effected substantial savings for all customers by eliminating the heavy costs, uncertainties and inconveniences of relying on outside sources.

We offer you experience based on the design and construction of over 400 successful oxygen-nitrogen generators.

Specialists in Equipment for All Low-Temperature Processes

Air Products OXYGEN—NITROGEN—ARGON **Generators**

AIR PRODUCTS, Inc., Dept. F, Box 538, Allentown, Pa.

Kick the tires and hope for the best

The first car you bought. The world may have been yours as you rolled triumphantly on your way. Or perhaps your face was beet red as your best girl helped you push your investment the last part of the way home.

At your desk today, you place most orders by specification. You find quality control and performance tests useful safeguards. Still, conditions being what they are, too frequently you have to hope for the best.

What is your best protection? Probably you agree with other business men who were asked recently. These executives, who account for more than 85 per cent of all Multiwall bag purchases, spelled it out*: The reputation of the seller.

Union has been the acknowledged leader in paper packaging for 76 years. Multiwall buyers who specify Union know their bags are being supplied by the company best qualified to help them develop a better package.

They have a further reason for confidence. Union's record of fair play.

Fair play in pricing. Fair play in allocating bags. Fair play in regarding delivery dates as pledges to be met.

This is the kind of treatment that has influenced knowing Multiwall users to place a greater share of their orders with Union.

It is the kind of treatment you can depend upon.

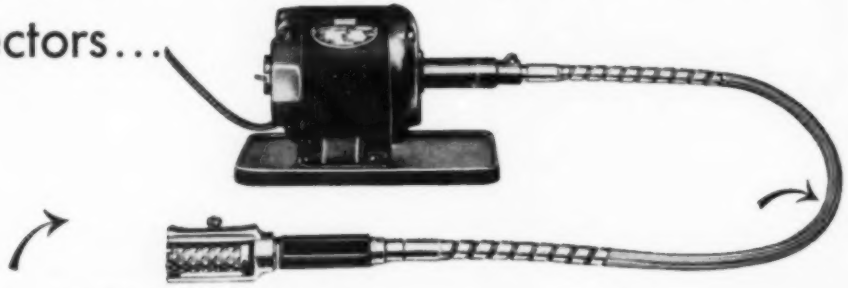
More so every day . . .

IT'S UNION FOR MULTIWALLS

*August, 1951 research study.

UNION BAG & PAPER CORPORATION • WOOLWORTH BUILDING, NEW YORK 7

If your product calls for action from connectors...

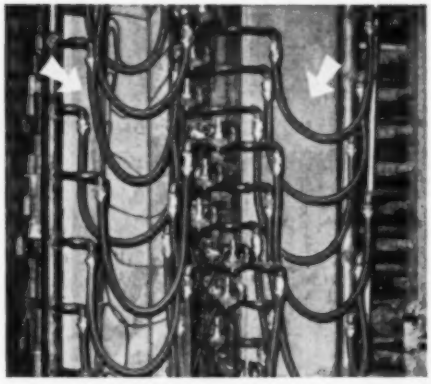


Fish Story: What could be easier than scaling a fish—if you use this model FSB Fish Scaling Machine made by The Belmar Corp., N. A. Strand Div., Chicago? The flexible shaft driving the cutter is protected in $^{7}/_{16}$" I.D. American Type SL Flexible Steel Hose jacketed with an outer braid.

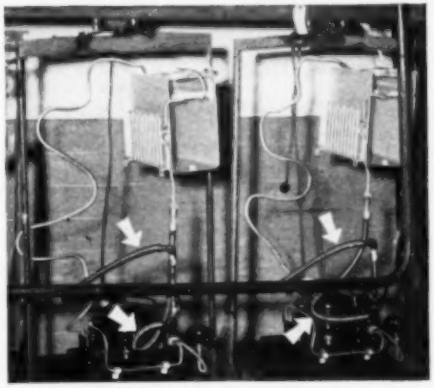
Use American Flexible Metal Hose or Seamless Tubing—the completely flexible metal connectors—where piping connectors move or vibrate; where ports are misaligned or for piping in cramped spaces where there's little room to work.

American Flexible Metal Hose and Tubing are available for carrying almost any liquid, gas or semisolid under severe conditions of corrosion, temperature, pressure and mechanical stress. You'll find full details in Bulletins SS-50 and CC-300. We would like to send you copies. The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Co., Ltd.

61242



Sandwich Maker: Sheets of plywood are bonded under heat and pressure. Heat for this Mesco hot-plate press of the Harbor Plywood Corp., Aberdeen, Wash., is provided by steam carried to the 21 platens in ½" I.D. American Seamless Flexible Bronze Tubing with single bronze braid.



Dry Fact on a Cold Subject: Before installation, every Norge household refrigeration unit is dehydrated by high vacuum in a drying oven. American ¼" I.D. Seamless Flexible Bronze Tubing connects each unit to the vacuum manifold. Specifications call for leakproof, corrosion-resistant tubing able to operate under 31" vacuum at an oven temperature of 280°F for 4 to 6 hours.

wherever connectors must move...

American ANACONDA

FLEXIBLE METAL HOSE AND TUBING

Large or small—you can PROTECT FANS and HOUSINGS with PLIOWELD

RUBBER LINING

SMALL OR LARGE, you can apply PLIOWELD lining to most metal surfaces. Goodyear equipment includes 15' diameter X 45' long vulcanizer—capable of handling equipment which can be transported.

7 REASONS WHY
THE G.T.M. SPECIFIES PLIOWELD

1 Effectively seals in corrosives that cannot be handled in metal

2 Bonds permanently to metal surfaces—an exclusive Goodyear process

3 Does not split or loosen with vibration or severe external impacts

4 Does not crack or buckle under alternate wetting and drying or under temperature changes

5 Surface will not disintegrate or slough off—*cannot ever contaminate in-process materials*

6 Protects product from discoloration, iron "pickup" and other contaminants

7 Each installation specially formulated to provide maximum protection against conditions revealed by G.T.M. study

WHEREVER you use an air stream to move corrosive fumes, you can assure yourself of longer, lower-cost service by coating impellers, fan blades, housings and duct work with PLIOWELD.

Every PLIOWELD installation—from smallest to largest—gets individual attention from the G.T.M.—Goodyear Technical Man. You can get his confidential advice on your problems by discussing with him such matters as nature of the fumes, temperature and velocity, the capacity, RPM, HP, etc., of the removal equipment.

Wherever you handle acids, alkalies, salts, or corrosive fumes, it will pay you to consult the G.T.M. about PLIOWELD—developed by Goodyear, a leader in bonding metal to rubber. Ask the G.T.M. about your problem, or write Goodyear, Akron 16, Ohio.

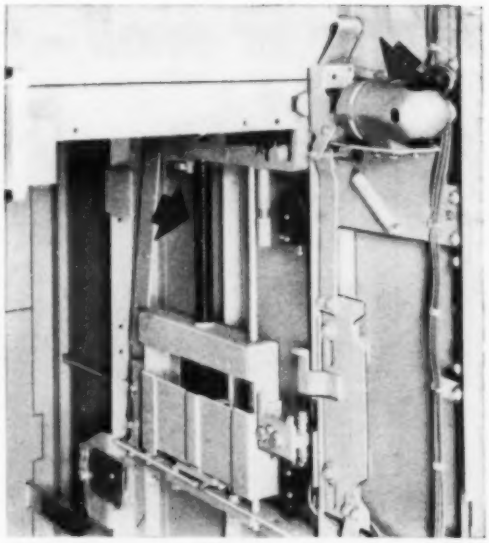
GOODYEAR

THE GREATEST NAME IN RUBBER

We think you'll like "THE GREATEST STORY EVER TOLD"—Every Sunday—ABC Network

Pliowald—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

REMOVABLE MAGNE-BLAST CIRCUIT BREAKER features improved flame-retardant insulation and simplified contact design. Breaker operating mechanism and control relay are on the front of breaker for easy accessibility.



NEW FASTER ACTING BREAKER ELEVATING MECHANISM can raise the removable circuit breaker into position, or lower it for testing, in 30 seconds. A new compact gear-motor drives the simplified jack screw elevating mechanism.

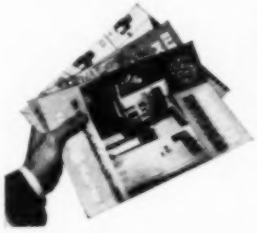
Improved G-E Metal-clad Switchgear

- - - - - - - STRONGER! SAFER! matched to today's demands for more dependable power for increased production

With fast-moving production schedules calling for more and more electric power, General Electric's improved Metal-clad Switchgear, in 4.16 kv and 13.8 kv ratings, answers the need for even greater power circuit protection and freedom from electrical shut-downs.

Retaining all the basic advantages pioneered in earlier G-E Metal-clad Switchgear and meeting all industry standards, this improved equipment offers a wealth of pace-setting design refinements. New features simplify operation and inspection and provide increased safety for personnel. And with stronger, more rigid construction and simplified design of many components, you get even more dependability.

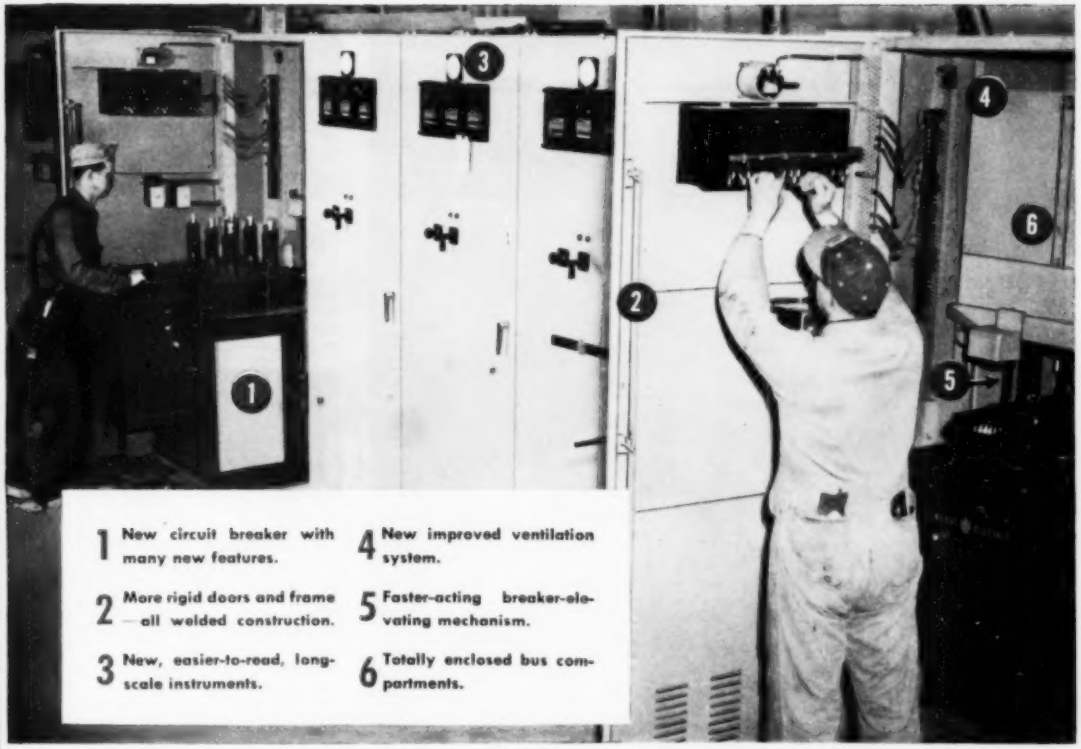
Look over the typical improvements shown here. Then get the complete story from your local G-E Apparatus Sales Office, or write to General Electric Company, Schenectady 5, N. Y.

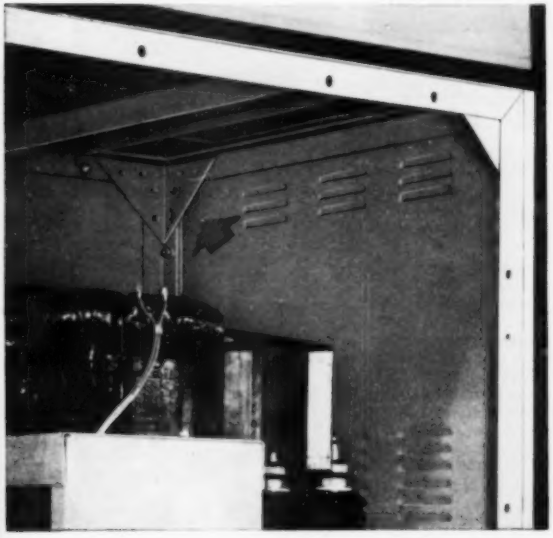


Complete data at your fingertips. Write for these helpful bulletins

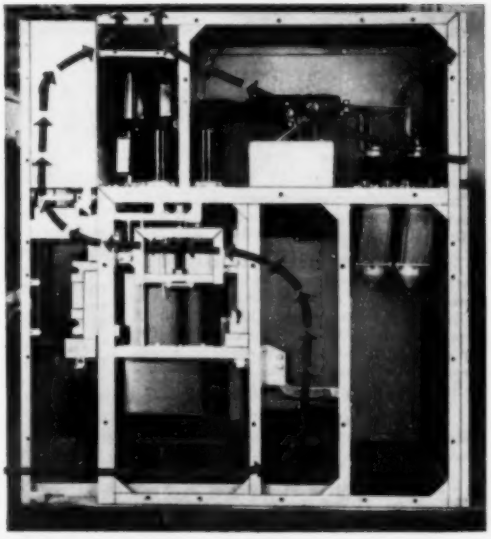
Full information on modernizing or expanding your electrical system with G-E packaged equipment is given in these three illustrated booklets. Write for GEA-5664 "G-E Metal-clad Switchgear," GEA-3592 "Load-center Unit Substations," and GEA-5600 "Power for Industry's Third and Biggest Expansion."

GENERAL ELECTRIC

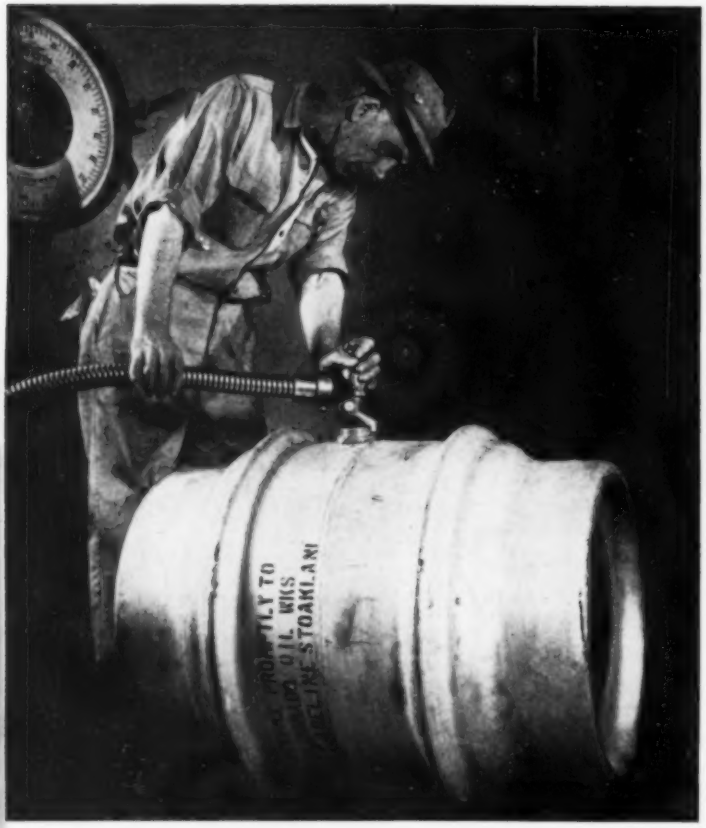

1 New circuit breaker with many new features.
2 More rigid doors and frame — all welded construction.
3 New, easier-to-read, long-scale instruments.
4 New improved ventilation system.
5 Faster-acting breaker-elevating mechanism.
6 Totally enclosed bus compartments.



FRAME NOW COMPLETELY WELDED into one solid unit. Gusseted corners (see arrow) provide greater rigidity. Doors have a three-point latch operated from a single handle, and are reinforced against warping by a steel tube at hinge side.



IMPROVED VENTILATING SYSTEM: Arrows show natural draft of air that constantly ventilates entire switchgear unit. The totally enclosed bus compartment, at upper left, is cooled by circulation of air around it.



THIS DRUM TAMED CAPRYLIC ACID

Caprylic is coconut oil's most corrosive, "toughest-on-containers" fatty acid. It is seriously discolored on contact with iron and many other metals.

El Dorado Oil Works, Oakland, producers of various coconut oil fatty acids, formerly shipped caprylic acid in one-trip, plastic-lined steel drums. But they had to be quick about it, for the acid attacked the plastic lining in from 30 to 45 days, which resulted in contamination and discoloration of the acid.

Two years ago El Dorado switched to Benson drums made of Kaiser Aluminum, and got these dollars-and-cents benefits:

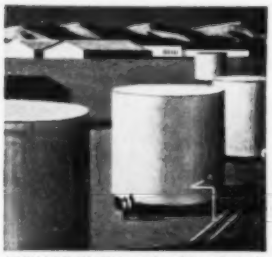
Aluminum drums withstand corrosion so effectively without lining that caprylic acid can be stored by El Dorado and its customers indefinitely—with no effect on color or quality.

Because aluminum drums are re-used again and again, expense of buying or reconditioning one-trip drums has been eliminated.

Although most Kaiser Aluminum today goes to meet the needs of the national security program, you can *plan now* to take advantage of aluminum in your future operations. For Kaiser Aluminum is expanding facilities to increase its production of primary aluminum 132 per cent!

EL DORADO OIL WORKS also tried stainless steel drums, but adopted returnable aluminum drums of the same capacity because they cost only half as much. They weigh only half as much, which cuts shipping costs!

RETURNABLE ALUMINUM drums have high resistance to corrosion—have no lining to break, no glass to shatter. And they're stronger than standard steel drums, will last longer.



STORAGE TANKS and railroad tank cars are among other applications of aluminum that have high corrosion resistance, minimum tendency to contaminate, longer life!

KAISER ALUMINUM & CHEMICAL SALES CO., INC., Oakland, California, is the sales agent for Benson Aluminum drums. Offices in principal cities. See your Classified Telephone Directory.

Kaiser Aluminum

Setting the pace—through quality and service

BLAW-KNOX

QUICK OPENING DOORS

FOR PRESSURE VESSELS

Rim-type ring locks door quickly and securely. Opening is positively sealed by internal pressure. No bolts or lugs.

Blaw-Knox Quick Opening Doors are used extensively on curing chambers, vulcanizers, and similar equipment. Those in use today are made in diameters up to 8 ft. and withstand temperatures to 400° F. and pressures to 300 psi.

FEATURES OF DESIGN

- Operate mechanically or hydraulically.
- No lugs, bolts, levers, or sliding bars.
- Self-sealing gasket positively operated by internal pressure.
- Smooth functioning ball bearing davit type hinges.
- Sections made from rolled or forged steel. No castings.

May be adapted to either horizontal or vertical vessels.

PROCESS EQUIPMENT DEPARTMENT

BLAW-KNOX

DIVISION OF BLAW-KNOX COMPANY
2090 Farmers Bank Building
Pittsburgh 22, Pa.
Other Offices in Principal Cities

ELLIOTT
equipment for power and process

Tops in

HERE'S WHY

this Elliott turbine is the natural choice among men who demand sound performance with low maintenance:

AIRWALL LABYRINTH SEALS WITH NO RUBBING CONTACT protect bearings against dust, fly ash, etc.—

CENTERLINE SUPPORT assures constant alignment at all times, irrespective of possible expansion due to temperature changes—

PACKING GLANDS REMOVABLE without raising upper half of turbine casing—

SHAFT IS SPRAY-COATED WITH STAINLESS STEEL under the packing gland, eliminating special maintenance after shutdown—

TURBINE BUCKETS AND SHROUD OF STAINLESS STEEL for maximum life and sustained efficiency—

ROTORS DYNAMICALLY BALANCED for smooth operation—

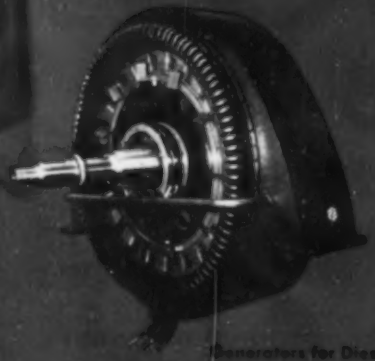
CONSTANT-SPEED GOVERNOR READILY ADJUSTED for permanent speed change—

BUILT-IN STEAM STRAINER of heavy stainless steel and

STANDARDIZED PARTS that fit all YR Turbines, greatly reducing parts inventory.

Bulletin H-16 has the full story. Phone or write your nearest Elliott office.

Generating Heaters



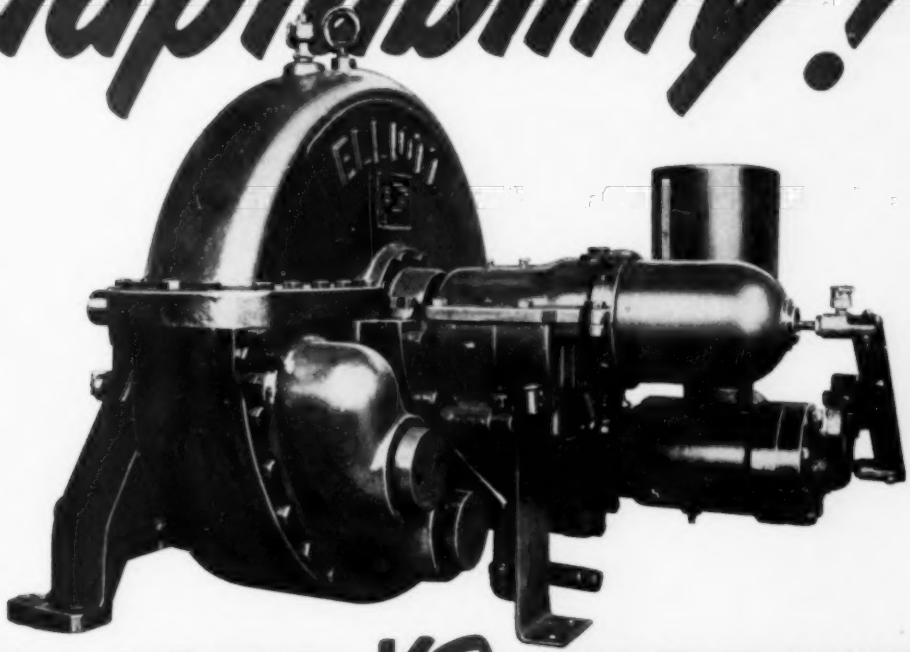
Generators for Diesels

Turbine Generators

Large Motors

Centrifugal Blowers

adaptability!



ELLIOTT YR TURBINE

HERE'S WHY *this popular turbine can be adapted to practically any operating conditions:*

- **Six elective control devices, including:**
  1. *Two handvalves controlling nozzling*
  2. *Hand-operated speed changer*
  3. *Remote control speed changer, air or electric*
  4. *High exhaust-pressure trip*
  5. *Remote control electrical trip*
  6. *Hand throttled emergency trip valve.*
- **Five frame sizes**
- **Eight different turbine types**
- **Your choice of several governors each independent of the standard overspeed governor**
- **Gland seal piping for condensing operation, or operation with gas**
- **Exhaust connection on either side**

ELLIOTT Company

Steam Turbine Dept. • JEANNETTE, PA.

Plants at: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

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Q2-5

Turbochargers for Diesels | Strainers | Steam Jet Ejectors | Mechanical Drive Turbines | Small Integral Motors | Tube Cleaners

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Equipment for the Chemical and Food Processing Industries

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Fabrication

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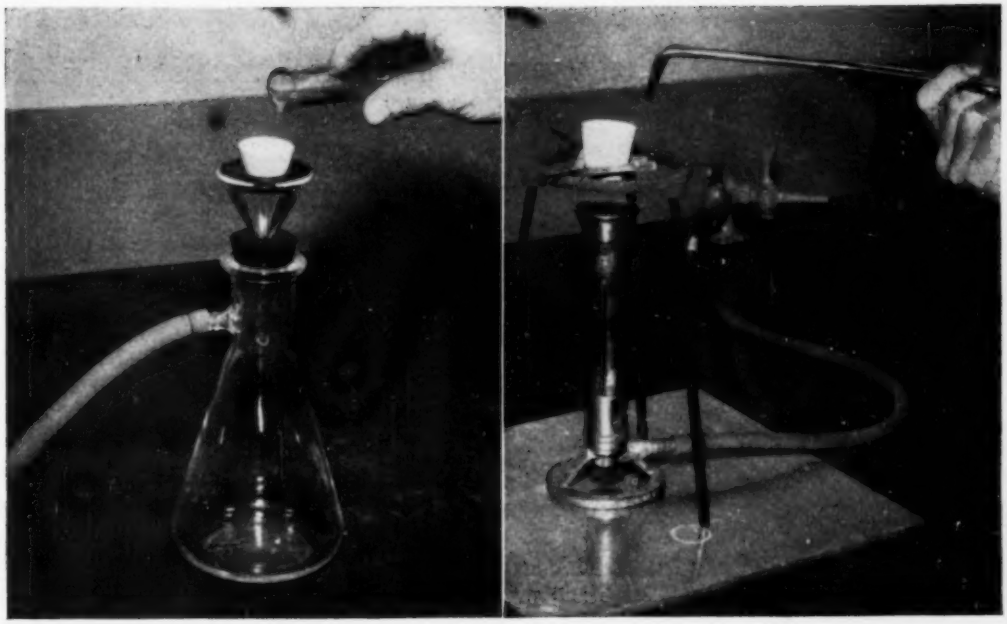


SERVING A DOUBLE PURPOSE. Filter crucibles of Norton ALUNDUM are unique in that precipitates may be both collected and ignited in them, without transfer to another receptacle. Photographs show how the same device is used for each of these two functions.

You save time and work with Alundum* laboratory ware

Made of purest fused alumina, expertly bonded and fired, Norton ALUNDUM laboratory ware offers technicians an exceptionally useful combination of properties. For example:

CHEMICAL STABILITY—ALUNDUM ware is unattacked by any organic solvent, being affected only by hydrofluoric acid, concentrated phosphoric acid and strong, hot caustic solutions.

HIGH MELTING POINT — Only slightly below that of its fused alumina base — 2050°C.

AMPLE POROSITY — Between 35% and 50% in most cases, with practically no closed pores.

EASY TO CLEAN — Cleaning highly refractory ALUNDUM ware is a simple process of washing and igniting.

More and more leading laboratories are specifying ALUNDUM ware because of its wider range of usefulness in such processes as filtering extractions, melting, incinerating, etc. Why not investigate its many advantages for your own experimental and analytical work?

NORTON ALUNDUM LABORATORY WARE is made in many shapes for many uses. The group shown includes crucibles, ignition capsules, flame collars, filter cones, dishes, discs and extraction thimbles.

GET BULLETIN 793

For complete data, including prices, contact your laboratory supply house, or write direct for Bulletin 793. Norton Company, 500 New Bond Street, Worcester 6, Mass.

*Reg. U. S. Pat. Off. and Foreign Countries

NORTON

Making better products to make other products better

Special

LABORATORY WARE

CARRIED IN STOCK BY MOST LABORATORY SUPPLY HOUSES

IT'S Bolltaron

AMAZING

Rigid, Non-Plasticized *Boltaron* 6200 Poly-Vinyl-Chloride

sets new standard for chemical resistance + lightness + strength

OTHER CHARACTERISTICS

WEIGHT — ½ aluminum, 1/6 steel. **TENSILE STRENGTH** — equals aluminum. **IMPACT STRENGTH** — Boltaron is dent-proof and, under normal conditions, shatter-proof, too.

WORKABILITY—Saws and shears smoothly without chipping. May be sawed right on the job with ordinary carpenter's saw or hacksaw.

Machines as easily as brass or aluminum. Punch, dink, bore, tap, thread, sand, polish. Easily formed to any shape at 300°F. May be vacuum molded or pressure molded.

May be extruded into pipe or solid round bar stock in standard 10 foot lengths.

Welds easier than steel — easily fused with low temperature hot air torch.

Can be efficiently fastened with screws, bolts, rivets or special cements where welding facilities are not available.

AVAILABILITY — Distribution is limited to selected fabricators trained by the Hartwell Company. This ensures that your fabricator will make efficient and economical use of Boltaron 6200. All inquiries are processed by the Hartwell Company to ensure that the right fabricator is assigned to a given job. Your fabricator's representative will give you technical assistance in planning an installation and the Hartwell Company maintains a close liaison with all fabricators in case unusual technical problems occur. For further details, write to our home office, address below.

PARTIAL LIST OF USES

Electroplating

Anodizing

Dyeing & Bleaching

Tanning

Brewing

Food processing

Dairy products processing

Textile processing

Photographic processing

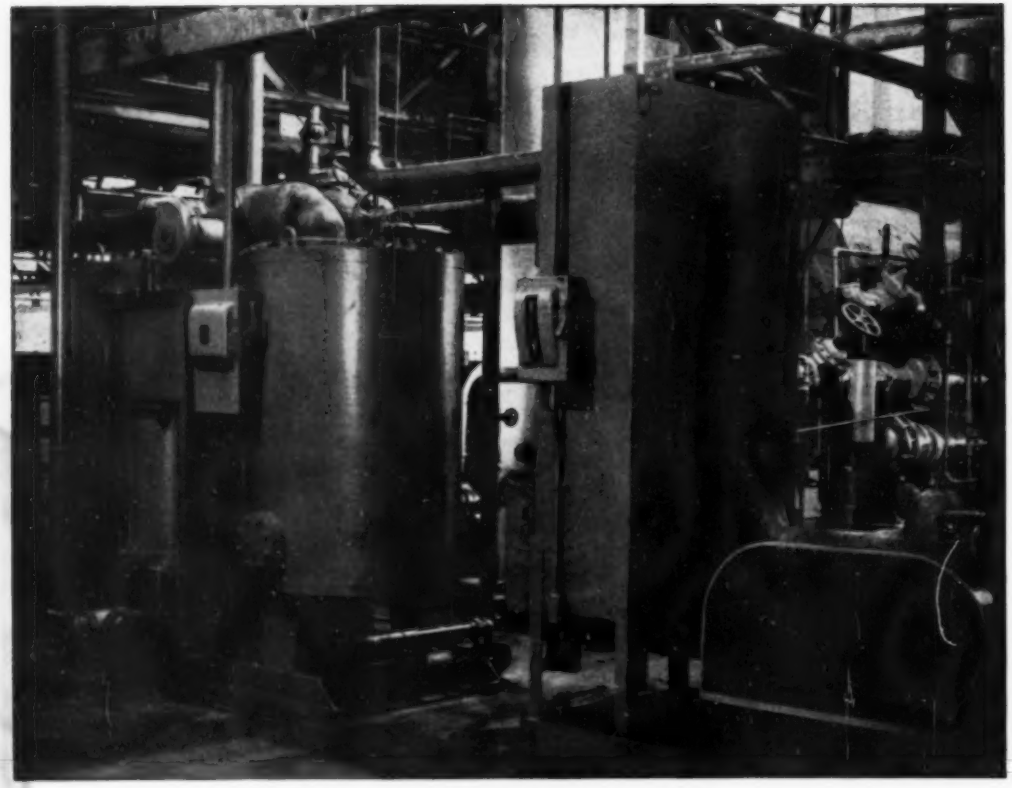
Industrial plumbing

• • •

Boltaron 6200 is *manufactured by* **BOLTA, Lawrence, Mass.**

H. N. HARTWELL & SON, INC.

Industrial Plastics Division • Park Square Building, Boston 16, Mass.



BWC Lectrodryer at left is DRYing gas down to-40° F. dew point after it has been cooled in gas refrigerator at right.

Caterpillar keeps controlled atmospheres on Tap

and Lectrodryers keep the atmospheres Dry

In Caterpillar's modern heat-treat department, controlled atmospheres are literally kept on tap. Gas from Neutralene generators passes through Lectrodryers* for DRYing and is then piped throughout the vast building.

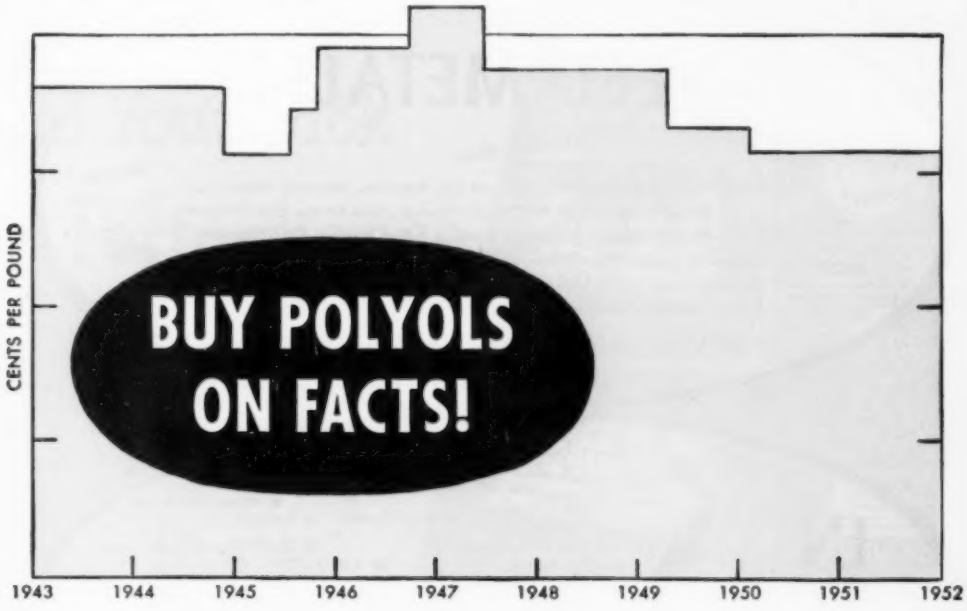
Eliminating the WETth that threatens quality or costs—or both—is the job that Lectrodryers do for you continuously, automatically, economically. If you have a DRYing problem of any kind, Lectrodryer engineers will help you solve it. Just write Pittsburgh Lectrodryer Corporation, 303 32nd St., Pittsburgh 30, Pa.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sydney.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U. S. PAT. OFF.



FACT No. 1 . . . ***Price and Price Stability***

The price trend of sorbitol continues downward as production is increased. Its price stability alone makes it the "best buy" in polyols.

FACT No. 2 . . . ***Performance***

Sorbitol and other related Atlas polyols frequently outperform similar polyhydric alcohols. Sorbitol has a better taste, greater purity. It is utilized by the human body as food. Sorbitol has a narrower humectant range than other conditioners and is chemically stable.

Used in cosmetics, tobacco, glue compositions, protective coatings, food, pharmaceuticals, and other products, sorbitol has proved its quality characteristics.

FACT No. 3 . . . ***Availability***

Sorbitol, derived from an almost inexhaustible supply of sugar, is available in almost unlimited quantities.

Write today for the valuable 22-page Atlas sorbitol book containing charts, usage tables, and other helpful data. Personal technical assistance is available at your request.

Industrial Chemicals Department

ATLAS POWDER COMPANY

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ATLAS POWDER COMPANY, CANADA, LTD., BRANTFORD, CANADA

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ALUMINUM

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COPPER

MONEL*

INCONEL*

NICKEL*

STEEL

Sheet, Plate, Tube, Pipe, Wire, Rod and Bar, Extrusions, Structural Shapes... and the following INDUSTRIAL PRODUCTS: Fasteners, Tube Fittings, Pipe Fittings, Valves, Silver Brazing Alloy, Welding Material, Solder, Castings, Tube Expander Equipment, Liquid Plastic Protective Coating, Metallic Caulking Compound, Aluminum Metal Trim, Waterproof Barriers, Nails, Handrail Fittings, Low Melting Alloys, Aluminum Jacketing, Wire Cloth and Rope, and "O" Rings.

Precision Equipment for Shearing and Slitting

*Not stocked in Kansas City or St. Louis territories.

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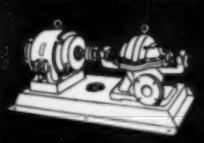
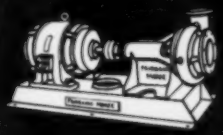


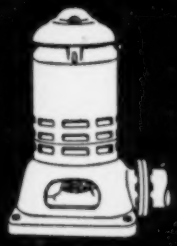
Two-Stage Centrifugal Pumps
Capacities: 100-560 G.P.M.

Builtogether
Centrifugal Pumps
Capacities: 5-1000 G.P.M.

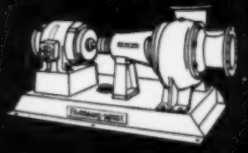
Frame Constructed
Rotary Pumps
Capacities: 1.3-450 G.P.M.



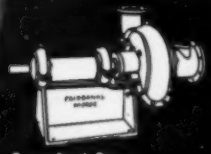
Base-Mounted Centrifugal Pumps
Capacities: 25-3000 G.P.M.



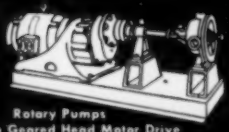
Deep Well Turbine Pumps
Capacities: 15-25,000 G.P.M.



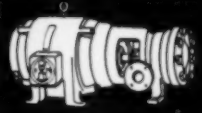
Horizontal Angle Flow Pumps
Capacities up to 100,000 G.P.M.



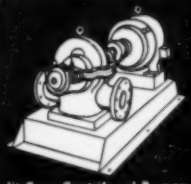
Paper Stock Pumps
Capacities up to
2500 G.P.M.



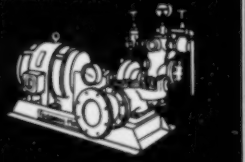
Rotary Pumps
With Geared Head Motor Drive
Capacities: 20-450 G.P.M.



Two-Stage Builtogether Pumps
Capacities: 5-1000 G.P.M.



Split-Case Centrifugal Pumps
Capacities: 50-50,000 G.P.M.



Centrifugal Fire Pumps
Capacities: 500-2000 G.P.M.

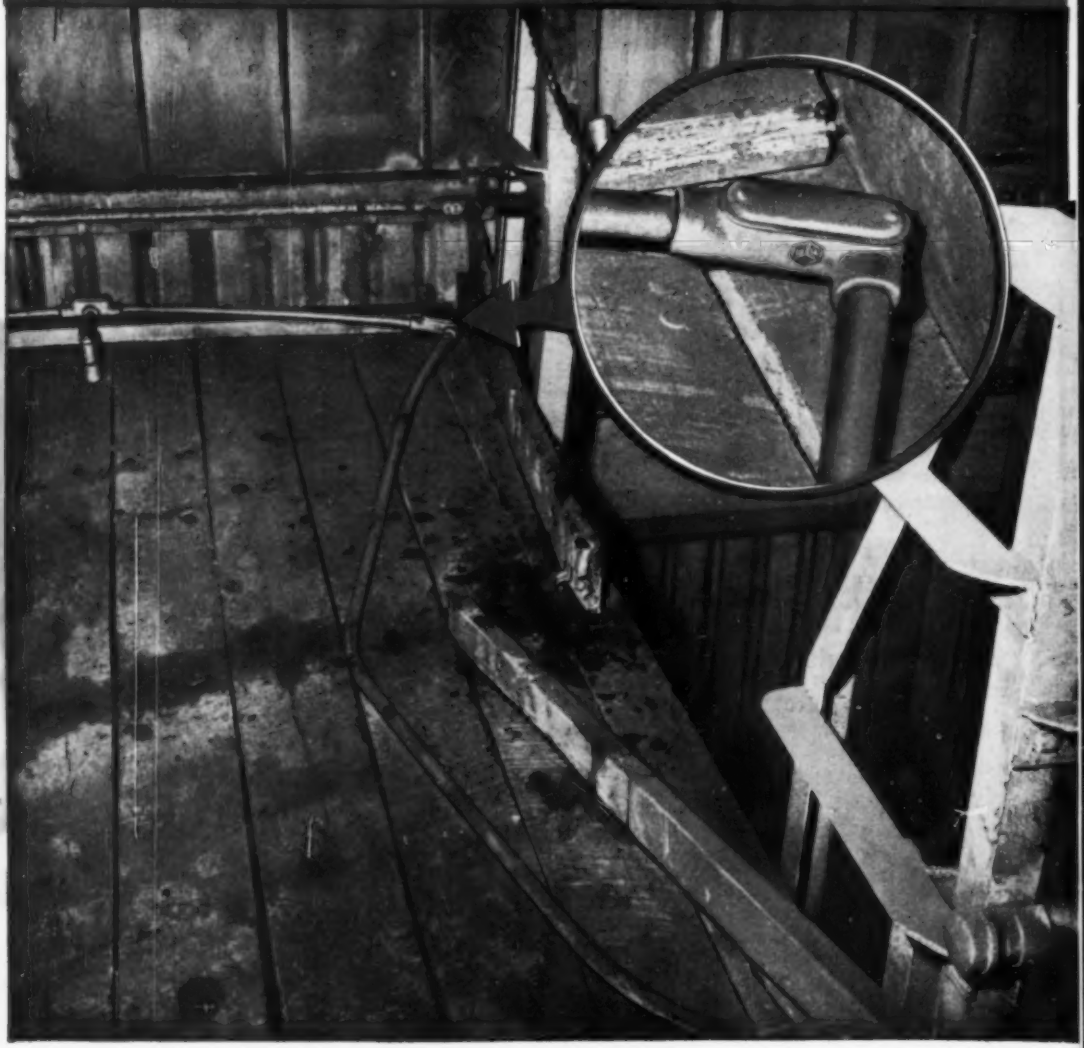
Vertical
Propeller Pumps
Capacities:
1250-216,000
G.P.M.

Bladeless Impeller
Food Handling Pumps

Sewage and Trash Pumps
Capacities: 50-20,000 G.P.M.

Vertical Angle Flow Pumps
Capacities up to
100,000 G.P.M.

The CONDULET* and rigid



Photograph of an actual case which proves the protective value of CONDULETS and rigid conduit. In an iron foundry, the conduit was accidentally hit by a heavy bucket full of iron, which bent it 21½ inches out of alignment and exerted a heavy strain on the CONDULETS. The CONDULETS withstood the pressure and there was:

NO distortion of the CONDULET. Cover remained tight
NO interruption of electrical service
NO shutdown
NO lost production

*CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

CONDULETS • TRAFFIC SIGNALS

conduit method gives you the

UTMOST PROTECTION
to electrical conductors

To maintain continuous production, it is important that all electrical wiring be protected against accidental mechanical damage which might result in costly shutdowns. Crouse-Hinds cast Feraloy **CONDULETS** and rigid conduit give you the best possible protection to electrical wiring and equipment.

The illustration at the left is an actual photograph of the kind of accident that is not uncommon in industry. Traveling cranes, electric trucks, or other heavy moving equipment frequently strike the electrical system. **CONDULETS** and rigid conduit can protect your electrical installations from damage by such accidents.

Remember . . . it pays to give your electrical system the protection that is only provided by the **CONDULET** and rigid conduit method.

Other Definite advantages

- **MECHANICAL PROTECTION.** Crouse-Hinds sturdy cast Feraloy CONDULETS and rigid conduit provide the best possible protection against accidental damage to the wiring and equipment. Prevents costly shutdowns.
- **FLEXIBILITY.** A modern CONDULET installation provides for growth and changing conditions. CONDULETS with detachable hub plates can be used to make it easy to change circuits or add new ones.
- **ECONOMY.** The installed cost of Crouse-Hinds CONDULETS and rigid conduit compares favorably with other wiring methods. The added advantages make it the really economical method that pays dividends over the years.
- **UNIVERSAL APPLICATION.** You can install galvanized CONDULETS and galvanized rigid conduit under all atmospheric conditions and in all occupancies.
- **CORROSION RESISTING.** Cast Feraloy CONDULETS give the best protection wherever moisture, dust, or corrosive atmospheres are present.
- **QUALITY.** The trademark CONDULET stands for the highest quality, reliability, and long life.
- **VARIETY.** More than 15,000 items are listed in the CONDULET Catalog, including a complete explosion-proof and dust-tight line for use in hazardous locations.

On YOUR next electrical layout, plan to get all the benefits of sturdy cast Feraloy **CONDULETS** and rigid conduit . . . the universal wiring method.

A Nationwide Distribution Through Electrical Wholesalers

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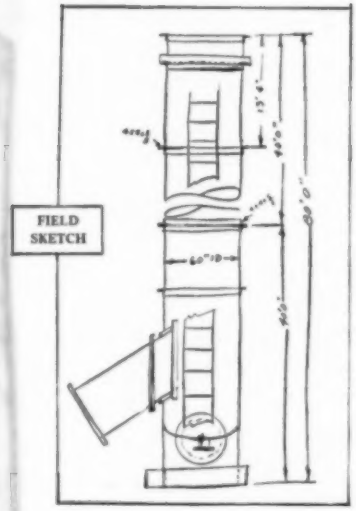
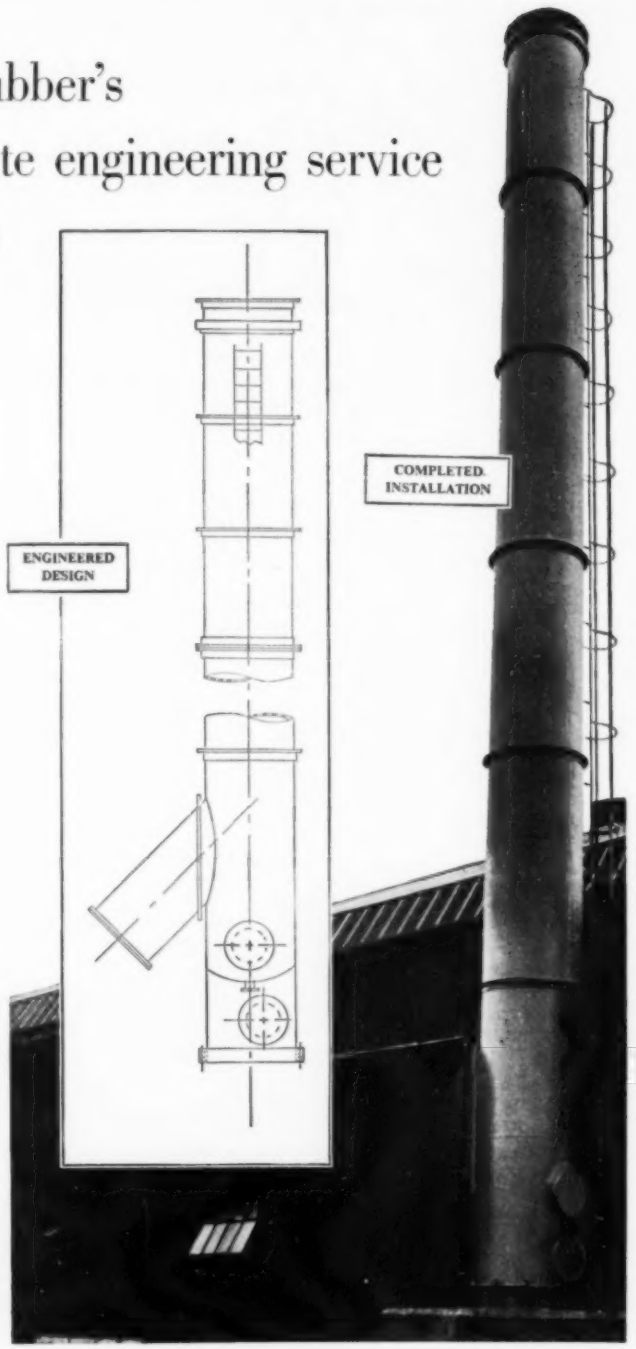
CONDULET — First in the field — STANDARD OF QUALITY

AIRPORT LIGHTING • FLOODLIGHTS

How U. S. Rubber's complete engineering service combats corrosion





This steel mill was faced with the difficult problem of exhausting corrosive gases resulting from its pickling operations. A U.S. Rubber engineer was consulted, and he designed this rubber-lined steel stack, 80 feet high and 5 feet in diameter.

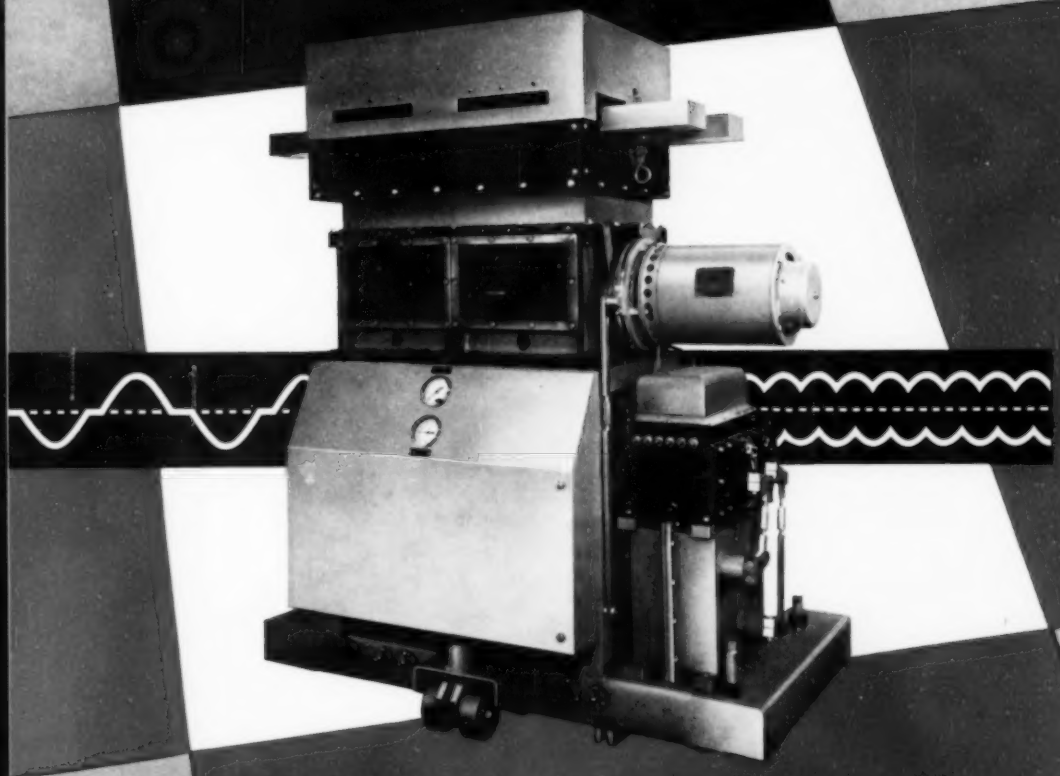
Fabricated, rubber lined and installed under his supervision, its successful operation serves as one more positive example of the complete engineering service available to industry to combat corrosion. Write to address below.

PRODUCT OF U.S. RUBBER SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

How to convert A-C to D-C with 96% overall efficiency!



By using an I-T-E Mechanical Rectifier

users of *heavy* d-c current (3000 amperes or greater) can convert a-c to d-c in the 50 to 400 volt range with an *overall* efficiency of 94% to 96%. By overall efficiency we mean from a-c line to d-c bus! This includes all losses—transformer, reactor, auxiliary devices, contacts, and control circuits. A glance at the following pages will give you the facts on the amazing efficiency and economy of the I-T-E Mechanical Rectifier.

I-T-E MECHANICAL RECTIFIER

How it works

Take a sine wave

Modify it like this with a *Permeron-core reactor

Make contact here Break contact here

Do it 1,296,000 times an hour and get this

...with a conversion efficiency of 96% or better

*I-T-E's special saturable core material.

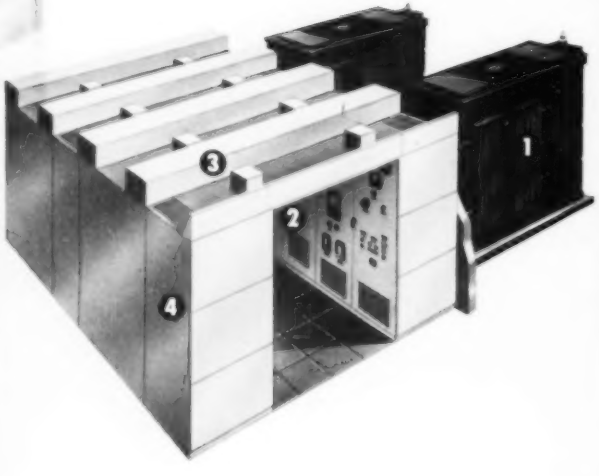
CAPACITY RANGE

3000, 4000, 5000, 6000, 7000, 8000, 9000 and 10,000 amperes in any voltage from 50 to 400 volts d-c.

Primary voltages up to 25,000 volts, three phase a-c.

One or more units may be connected in parallel to give any higher d-c current rating.

A Complete Installation



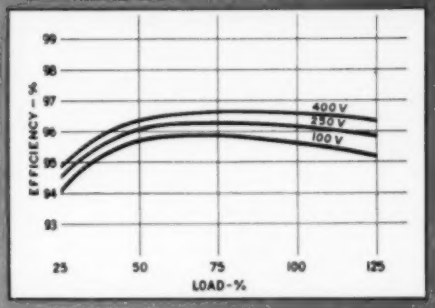
A complete I-T-E Mechanical Rectifier installation includes a transformer, commutating reactor, contact mechanism, d-c switchgear and associated instruments and controls. A-C supply is fed into the *combined* transformer and commutating reactor (1). The reactor is made with the special core material, Permeron. Its use puts a "step" in the sine wave of the a-c current. From the reactor the "stepped" sine wave travels into the contact mechanism (2). By breaking the circuit during the step at zero current, the contact mechanism converts a-c to d-c without arcing. From the contact mechanism d-c current travels through the overhead bus (3) to the d-c switchgear (4) which feeds the load.

I-T-E MECHANICAL RECTIFIERS

94 to 96% efficiency over 25 to 125% load range!

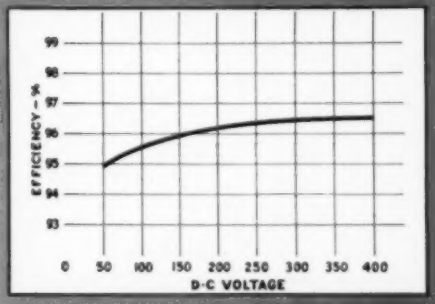
LOAD—EFFICIENCY

One of the chief advantages of the I-T-E Mechanical Rectifier is its consistently high efficiency over a wide load range. A glance at the load—efficiency curve shows Mechanical Rectifiers have very close efficiencies even with a difference of 300 volts in rating. Note too, the high efficiency at only 25% of rated load.



D-C VOLTAGE—EFFICIENCY

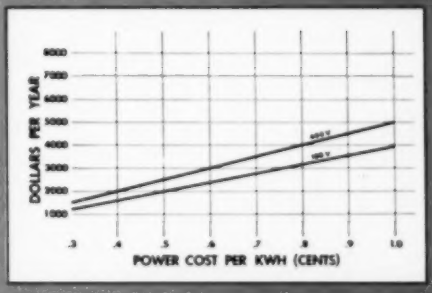
The curve d-c voltage—efficiency, shows that within the 50 to 400 volt range, Mechanical Rectifiers hold their efficiency within a very narrow zone. This means d-c can be efficiently utilized at lower voltages than formerly possible.



Cuts Power Bills!

POWER COST—SAVINGS

The power cost—savings curve developed here from figures published by *Chemical Week* shows the savings possible with I-T-E Mechanical Rectifiers, operating at 100 volts and 400 volts. Where large blocks of power are used, even a slight improvement in efficiency can save thousands of dollars. Suppose for example, you are purchasing 2000 KW for 24 hour operation, 350 days a year. A simple calculation will show how much you can save with only a 3% gain in efficiency, brought about by using a Mechanical Rectifier:



2000 x 24 x 350 = 16,800,000 KWH/year

With a 3% improvement in efficiency you save:
(16,800,000) (.03) = 504,000 KWH/year

Assuming a nominal industrial rate of 7 mills/KWH
(504,000) (.007) = **$3,528** yearly saving.

I-T-E MECHANICAL RECTIFIERS

...offer these advantages:

- HIGH EFFICIENCY—superior to that of any other type of low-voltage rectifier. 94% to 96% over a wide load range.
- SMALL SPACE REQUIREMENT—extremely compact metal-enclosed units of modern design.
- LOW BUILDING INVESTMENT—no need for special foundations, high ceiling or crane facilities.
- LOW INSTALLATION COST—no special equipment needed for installation. Just unload, put in place, connect, and operate.
- AVAILABILITY FOR SERVICE—no waiting required for equipment to warm-up or get up to speed.
- LOW MAINTENANCE COST—main contacts need only occasional replacement. Auxiliary equipment is reasonably maintained because of light duty and standard nature.

When planning new or expanded conversion facilities you can take full advantage of I-T-E products all along the line. For in addition to the Mechanical Rectifier, I-T-E can supply unit substations, a-c and d-c switchgear, individual circuit breakers and bus. By specifying I-T-E all the way from the power company's line to individual load, you'll have a completely integrated, uniform power system. The system will be safe, efficient, and practical because it was designed and built by specialists.

HERE'S USEFUL INFORMATION ON SELECTING POWER CONVERSION EQUIPMENT

Write for the following bulletins. They'll tell you more about the Mechanical Rectifier and what it will do for you.

BULLETIN 5106 —Covers simple theory, space requirements, and standard arrangements.

BULLETIN 5204 —Gives details on I-T-E's special magnetic core material "Permeron."

BULLETIN 5205 —Deals with the engineering aspects of the I-T-E Mechanical Rectifier's efficiency.

I-T-E

MECHANICAL RECTIFIERS

I-T-E CIRCUIT BREAKER COMPANY

Mechanical Rectifier Division

19TH AND HAMILTON STREETS, PHILADELPHIA 30, PENNSYLVANIA

Canadian Mfg. and Sales: Eastern Power Devices, Ltd., Toronto

Export Sales: Philips Export Corp., N. Y. 17, N. Y.

Where you will find THE REAL REVOLUTION

"If we keep in mind the values of opportunity, competition, democracy, productivity, then it is our capitalist society which is the truly revolutionary one – the only society which offers true hope to the masses for release from the long nightmares of tyranny. It is we, not the Marxists with their reactionary ideas of the good dictator, who have the truly constructive, the truly revolutionary ideal."

– from "Capitalism" by David McCord Wright.

If we can only win recognition of this truth, we shall win the struggle of free men against communism. This editorial discusses some of the hurdles that must be cleared.

To win the needed recognition that "our capitalistic society... is the truly revolutionary one," we must keep pounding away both abroad and at home. That is because the communists simultaneously attack us on an international front and try to undermine us from within.

The present drive to rearm ourselves and our allies is crucial to our self-protection on the international front. We must be prepared to meet the armed force of aggressive communism with armed force if we are to secure our physical freedom.

Arms are not enough

But to re-establish parity in arms is only half of the battle. In the last analysis it is not the more important half. To be effective, our arms must be backed by loyalty of men to our ideals. So, both abroad and at home, we must win men to the faith that we do have "the truly constructive, the truly revolutionary ideal."

On the international front, the effort to win adherence to such faith in our capitalist society meets tough going. That arises from the fact that in some of the countries that are allied with us in the fight against communism, capitalist society has offered to its people no such ideal. In varying degrees "the values of opportunity, competition, democracy, productivity" – those key aspects of American capitalism – are either absent or subordinated in their economic life. Indeed, the *Wall Street Journal* recently remarked that "to the European, capitalism has become synonymous with cartels – and with the disregard cartels foster for the consumer, the worker and the over-all well-being of the nation's economy."

No Simple Solution

Nonetheless, many European labor and governmental leaders sincerely believe that cartels are essential to their economic salvation. They believe that without such restrictions in congested European markets there would be intolerable cut-throat competition and instability of employment. Thus, when we point out that the cartel capitalism so prevalent in Europe lacks the constructive qualities of competitive American capitalism, we may offend European leaders whose wholehearted cooperation we need in the fight against communism.

But, if we soft-pedal that contrast, we sacrifice the opportunity to win understanding and loyalty from millions of Europeans who have had no chance to learn that capitalism can be the constructive and liberalizing force that it is in the United States. Indeed, when many of these millions embrace socialism it is not because they love it. They are rather desperately seeking a tolerable middle course between what they consider the hateful extremes of communism and the undesirable aspects of capitalism as they understand it.

New name not the answer

We know that there is no easy way to handle the problems created by such misunderstanding of American capitalism. Neither do we share the belief that much of the difficulty would be overcome if we were to call American capitalism by some other name. By doing that, the argument runs, we shall relieve it from the unpleasant connotations that are attached to the word capitalism in some other parts of the world. But, after all, if we are to give up all the terms that have come to mean something else in other parts of the world, we must begin by ditching the term "democracy" which, in the official jargon of the Kremlin, seems to mean what we call dictatorship.

In spite of the difficulties, however, we must stick to this job of exporting the truth that our capitalist system does offer opportunity, competition and democracy. We must let the rest of the world see that it means a continuous drive for increased productivity, and the search for profits by increasing sales and consumption, not by trying to sell less for more.

Export alone not enough

The spreading of truth about American capitalism will not be effective if it is merely directed abroad. Unless it is carried on at home also, it will lack the driving faith that is essential to any convincing export of this type. Nor will export alone come to grips with the communist attack on our country from within—an attack that gets too much help from loyal Americans who short-sightedly repudiate the basic principles of our institutions in their efforts to reform some of their deficiencies. For success both at home and abroad, we must have right here at home a much more militant recognition that it is in fact our capitalist society which offers "the truly constructive, the truly revolutionary ideal."

Here at home, too, this raises difficult complications. Businessmen who are among the leaders and principal practitioners of capitalism, have generally been catalogued as conservatives. Hence, many people must stretch their imaginations a bit to see that businessmen are leaders of a development which has so greatly and so rapidly improved the lot of free men in America that it is truly revolutionary.

These difficulties of definition, however, are relatively superficial aspects of the problem of seeing our capitalist society clearly. The basic facts are that:

American capitalism is leading free men to an ever higher material standard of living while respecting their spiritual, social and political freedom.

Communism is leading its people back into a life of servile regimentation under dictatorship.

American capitalism advances to high ground never before attained by free men. Communism retreats to ground that men with an appetite for freedom throughout the ages have sought to escape. If we can establish this truth firmly, around the world, we shall no longer need to worry about communism. It will be hopelessly sunk.

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Naugatuck

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Known by the customers we keep . . .

Here are just a few of our many customers . . . and the products we helped them make finer.

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American Optical Company
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Pipe Fittings
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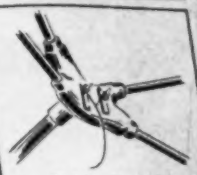

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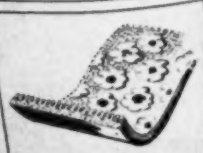


Adherenna Carpet
Magee Carpet Company
LOTOLS

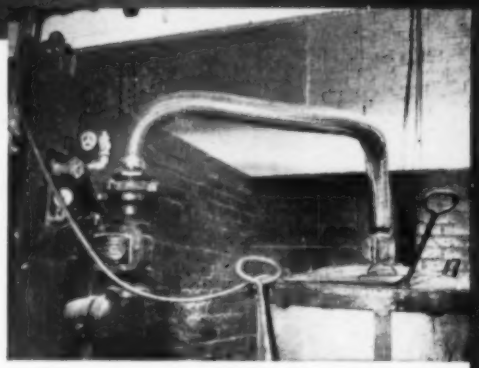
Naugatuck Chemical

Division of
United States Rubber Company
Naugatuck, Conn.

•

Marvinol® vinyls
Kralastic® styrene copolymers
Vibrin® polyesters

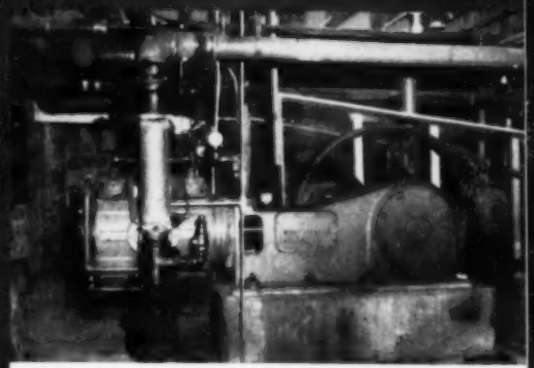
IF the connection must move . . .



use CMH flexible metal hose

In conveying materials—liquids, gases or dry granular solids—between two movable points, metal hose combines rugged durability with the required flexibility. In addition, metal hose is non-aging, non contaminating and non-collapsible. It offers high resistance to heat, cold and physical damage, giving excellent service under all conditions.

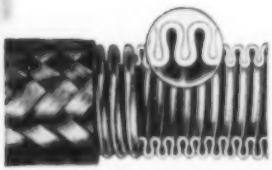
IF the connection vibrates . . .



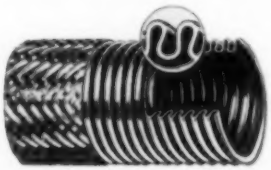
use CMH flexible metal hose

Connections subject to vibration will last longer if they are made with flexible metal hose. Equipment and rigid piping will last longer, too, because metal hose isolates the vibration, restricting it to that portion of the equipment that is built to absorb the vibration. Transmission of noise is minimized also, with metal hose connections.

There is a size and type



CMH REX-WELD corrugated steel and bronze hose is available in standard sizes from 3/16" through 12" I.D. for burst pressures to 12,000 psi, temperatures to 1000° F. Available with or without metal braid covering.



CMH REX-FLEX corrugated stainless steel hose is available in standard sizes from 5/16" through 6" I.D. for burst pressures to 24,000 psi, temperatures to 1600° F. Available with or without metal braid covering.

CMH REX-TUBE fully interlocked flexible tubing for ducting, exhaust, armor etc. is available in galvanized steel, aluminum, brass and other metals in sizes 1/8" through 12", I.D.

Descriptive literature available on all CMH hose types.

CHICAGO METAL HOSE

1317 S. Third Avenue Maywood, Illinois

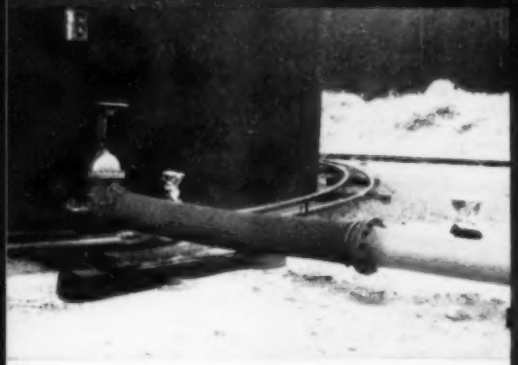
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Manufacturers of Flexible Metal Hose, Metallic Bellows,

CMH

Flexon identifies CMH products that have served industry for over 50 years

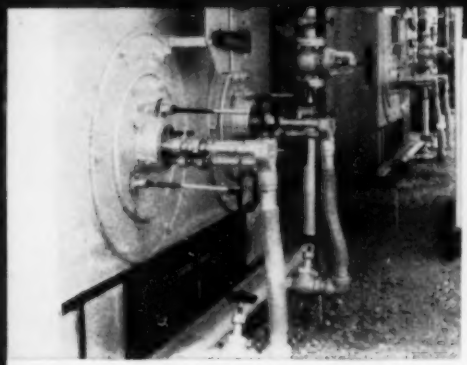
IF the connection is misaligned . . .



use CMH flexible metal hose

Joining misaligned sections of piping is greatly simplified when flexible hose is used to bridge the gap. Savings in assembly time and in fittings generally will pay the cost of the hose. At the same time, metal hose provides a neater installation that is practical, efficient and completely leaktight and dependable.

IF the connection absorbs expansion . . .



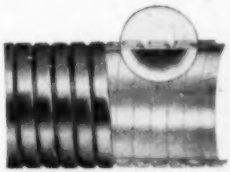
use CMH flexible metal hose

In the many types of equipment where thermal changes cause expansion and contraction, the motion is easily absorbed by flexible metal hose without sacrificing any of the tightness or dependability of the connection. Flexible metal hose makes it possible to solve an otherwise difficult problem quickly, simply and economically.

to meet every need . . .

CMH REX-TUBE fully interlocked flexible metal hose for steam, tar and asphalt, grease, etc. is available in galvanized steel or bronze in standard sizes from ⅛" to 12", I.D.

CMH REX-TUBE ball bearing type utility hose for non-searching fluids is available in bronze, galvanized steel or stainless steel in standard sizes from 5/16" through 1½", I.D. Available with or without metal braid covering.



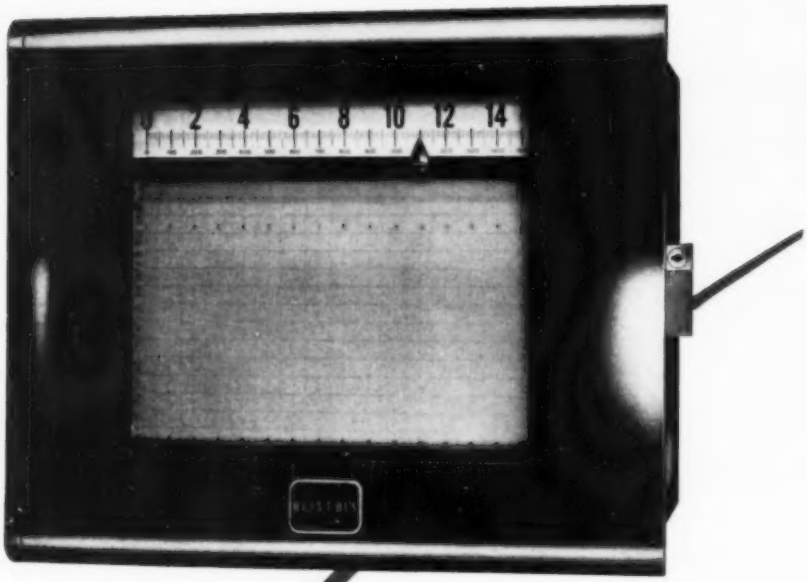
CMH "Abrasion Resistant" flexible galvanized steel tubing is especially designed for handling dry granular solids such as grain, slag, asbet, etc. Standard sizes 2½" through 12", I.D

See your classified telephone directory for the distributor nearest you.

Division, Flexonics Corporation

Plants at Maywood, Elgin, Rock Falls and Savanna, Illinois and Memphis, Tennessee

Expansion Joints for Piping, and Aircraft Components



CHECK the Versatility

of the BRISTOL DYNAMASTER

Continuous-balancing electronic instruments

Dynamasters can be used with "sensing elements" like these:

Resistance thermometers, strain gauges, conductivity cells, thermocouple or radiation pyrometers, tachometer magnetos, pH amplifiers, gas analyzers, X-ray and radiation thickness gauges, photoelectric cells, spectrometers, gas detectors, titrometers, and others

To measure, record and control quantities like these:

Temperature, pressure, volts, amperes, watts, thickness, liquid, flow, liquid level, load, weight, strain, torque, position, conductivity, ionization, rpm, illumination, density, and many others

BRISTOL

The dependable Guidepost of Industry

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

..and Double Check THESE FEATURES:

All types of electric and air-operated controllers offered

Continuous-balancing electronic circuit responds instantly to minute changes

Simple design assures trouble-free operation

Little or no maintenance

Circular or strip-chart models, single or multiple recorders

Electronic component uses vacuum tubes available at any radio supply house

Full-scale pen travel in 2/3, 3, or 7 seconds

Wide variety of chart speeds

Components interchangeable on all Dynamaster models, easily serviced or replaced

Exceptionally unaffected by stray currents (1000 to 1 discrimination)

Available in bridges or potentiometers

Practically immune to shock or vibration

AND THAT'S NOT ALL! *For more details, use the coupon to send for Catalog No. P1245.*

COMPANIES LIKE THESE *are using Dynamasters*

North American Cyanamid Limited
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Collins Radio Company
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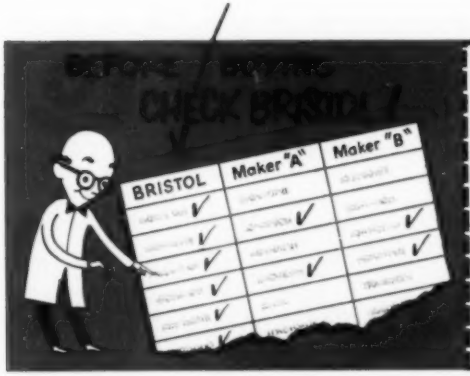


THE BRISTOL COMPANY
109 Bristol Road
Waterbury 20, Conn.

Please send catalog giving details of Dynamaster performance to:

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

HOW MUCH DO FILTER

. . . and what can you *do* about it?

Have you ever thoroughly investigated both the direct and indirect cost of filter cloths in your plant? If not, the chances are you will be surprised to find that annual cloth replacement and maintenance cost alone runs from $1.00 to $4.00 per square foot of press area per year, depending on the utilization of your press, the product and the type of fabric you use. Other costs associated with use of cloths, such as the labor for scraping, handling, washing; breaking and redressing the press; and purchasing time expended in obtaining the cloth you need when you need it will probably be even greater, even if not as easily pinned down.

Here are three immediate reasons why you should consider switching to modern high-speed Niagara pressure leaf filters:

1. Niagara Filters require no filter cloths. Accurate case histories in our files show that some plants amortize their Niagara filters in a few years on this saving alone.

2. Niagara Filters require less labor. When you eliminate filter cloths, you eliminate the back-breaking and costly labor that goes with them. With Niagaras you get a quick, easy, clean operation that takes only a few minutes for one man between cycles.

3. Niagara Filters provide greater utilization. Reduced down time means more production time, which means higher production at your filter station. The filter works for you more hours per day—gives you many more gallons throughput with less installed filter area.

By switching to Niagaras, many press users have realized overall savings that amortize the cost of the new filters in months. We can show you detailed case histories from our files presenting the economic soundness of replacing existing filter presses with Niagara filters.

Entirely aside from savings, here are eight sound reasons for installing Niagara filters:

1. Higher flow rates on an equal area basis. Niagaras normally give flow rates 2 to 5 times greater than conventional cloth covered filters.

2. Sparkling filtrate clarity. Positive removal of solids to practically any degree of clarity you desire. In sanitary applications, 0-0 bacteria count can usually be secured in one filtration.

3. No leakage. Fully enclosed, pressure-tight construction eliminates drippage and fumes. Ideal for handling flammable, explosive, toxic, volatile, or highly obnoxious liquors.

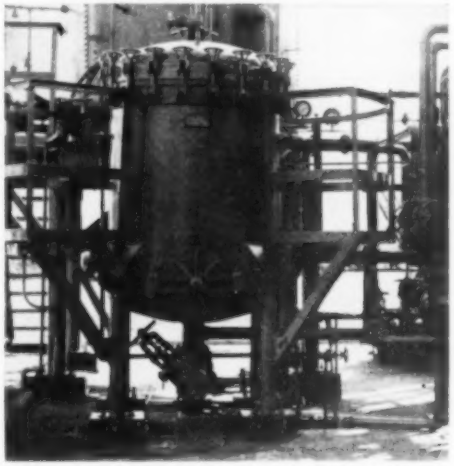
4. Wide capacity range. Sizes range from 20 to 950 square feet of filter area, with average capacity of 10 to 425 G.P.M. in one compact unit. (Even larger areas are available in the new horizontal filter shown at right on the opposite page.)

5. One-man operation and cleaning. Single or multiple units can be operated and cleaned easily by one man. The entire leaf battery is accessible for easy cleaning.

6. Corrosion-resistance. The pressure leaf filter can more cheaply and readily be constructed of stainless steel, nickel, monel and other corrosion-resistant materials.

7. Jacketed construction. Niagaras can readily be supplied with steam jackets or special insulation.

8. Excellent cake-washing characteristics. Nearly true displacement washing is obtainable.

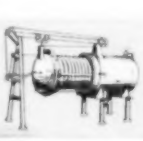


THIS NIAGARA FILTER, in large petrochemical plant, removes iron sulfide particles from solutizer solution.

HOW THE MODERN NIAGARA PRESSURE LEAF FILTER WORKS

The leaves, which are the heart of these filters, consist of double faced rectangular screen assemblies bounded by a tubular drainage frame leading to an outlet nozzle. The unfiltered liquid is pumped into the closed pressure filter tank in which the leaves are placed, and is forced through the fine mesh screen on which the filter cake is formed by the solids in the liquid. Only the clear liquid reaches the inside of the leaves, flowing through the coarse center drainage wire, to the tubular frames and out through the leaf nozzles to the manifold. When the designated batch

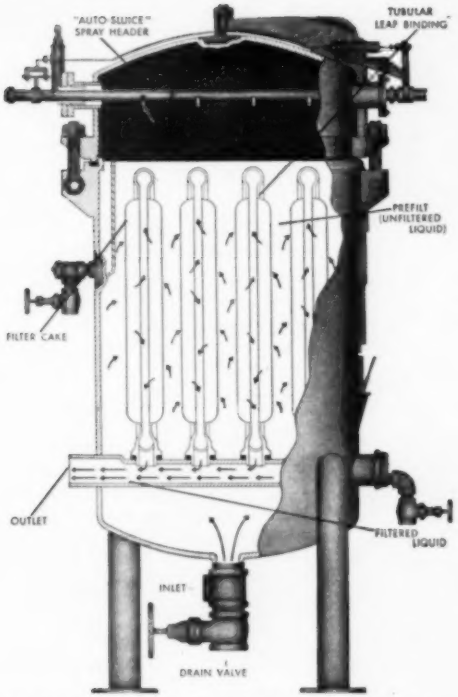
Niagara Filter
CORPORATION



HORIZONTAL FILTERS for non-aqueous liquids and high solids, and cake recovery applications.

IN EUROPE—NIAGARA FILTERS EUROPE, 36 Leidsegracht, Amsterdam-C, Holland

CLOTHS COST YOU?



has been completely filtered, or when the cake has nearly filled the space between the leaves, the filter is emptied and the filter cake is sluiced from the leaves with a hose or with automatic high pressure sprays. Sluicing is done without removing any parts from the filter. As a rule, the filter is ready to go to work again in 15 minutes to 1 hour, depending on its size.

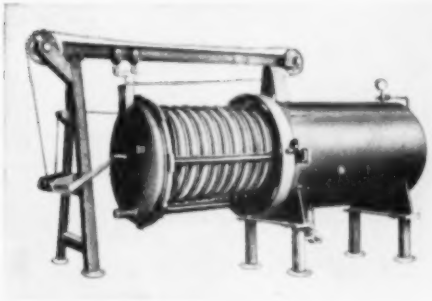
Reason for High Flow Rates

The rigid metal screens do not "give" under pressure—cannot obstruct flow channels in the drainage member as does sagging cotton cloth. Also, the filtrate drains by gravity as well as pressure. This combination of rigid metal leaves, plus bottom drainage, produces flow rates 2 to 5 times those of conventional filter presses.

There are no moving parts during filtration. This simple construction means lower maintenance costs, as any Niagara user will verify. Niagara filters are easy to keep clean and keep in operation.

Niagara's Five Helpful Filtration Services:

1. **Nation-wide field service.** Capable representatives in 24 cities.
2. **Complete testing facilities** help determine your requirements exactly.
3. **Pilot filter rental** enables you to "preview" Niagara performance in your plant, at low cost.
4. **Custom engineering.** A single filter or a complete system, designed for your exact needs.
5. **Installation and startup** are supervised by Niagara engineers, always on call.



NIAGARA'S NEW STYLE H* FILTER

for applications involving high per cents of solids

1. Gives 2-5 times the flow rates.
2. Cuts cleaning time to minutes.
3. Eliminates all cloth costs.

This new Niagara filter answers the need for a filter which can quickly discharge large quantities of semi-dry cakes. A variation of the standard Niagara design, it still retains all the basic advantages of Niagara vertical pressure leaf filters.

A retractable carriage permits all leaves to be withdrawn at once for rapid cleaning. One man can easily discharge as much as 150 cu. ft. of cake in a matter of minutes.

A new closure design, the Q/O* (quick-opening) cover, permits faster, easier opening and closing than ever before in a filter of this size.

The Style H* filter is ideal for filtration where high percentages of solids must be removed or where solids must be saved. It is also recommended for all standard liquid clarification where low headroom or other special reasons make its horizontal construction preferable to the vertical pressure leaf filter.

*Trade Mark Patent Applied For

STANDARD VERTICAL FILTERS for clarification and polishing.

"AUTO-SLUICE" FILTERS—fully automatic cake sluicing.

NIAGARA FILTER CORP., 3083 Main St., Buffalo 14, N. Y.

Please send me ☐ General literature; ☐ Data on horizontal filters; ☐ Data on pilot filter rental service

Name _____

Title _____

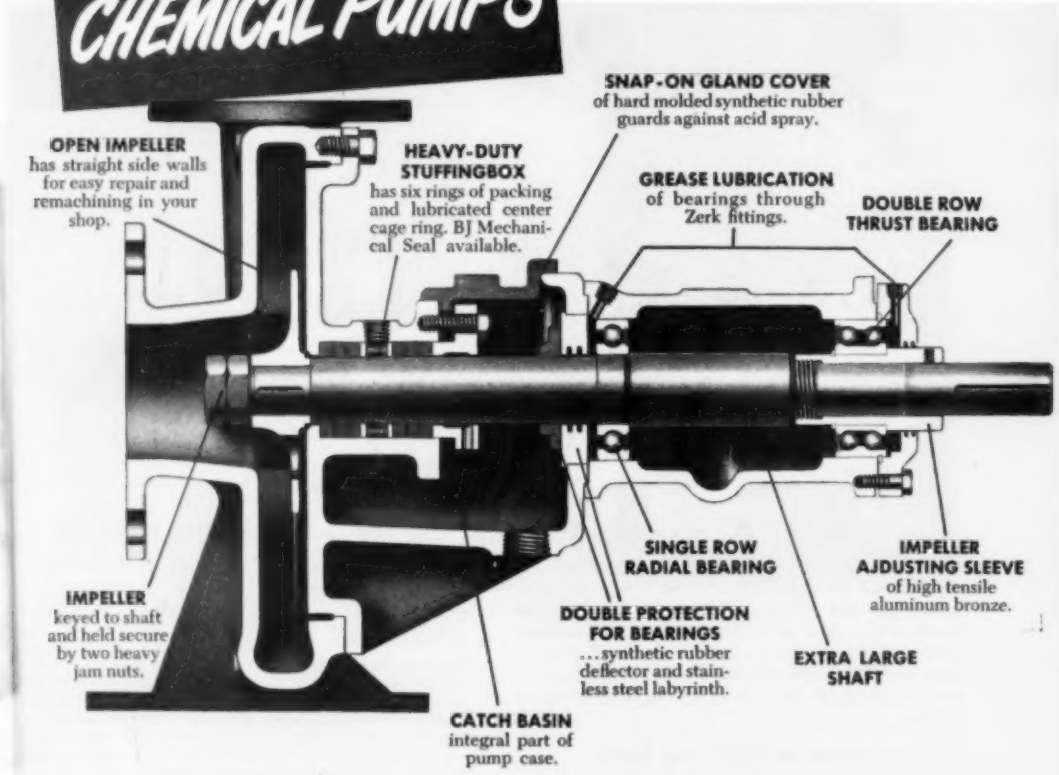
Company _____

Address _____

City _____ Zone _____ State _____

NEW BJ CHEMICAL PUMPS

Here are chemical


SNAP-ON GLAND COVER
of hard molded synthetic rubber guards against acid spray.
OPEN IMPELLER
has straight side walls for easy repair and remachining in your shop.
HEAVY-DUTY STUFFINGBOX
has six rings of packing and lubricated center cage ring. BJ Mechanical Seal available.
GREASE LUBRICATION
of bearings through Zerk fittings.
DOUBLE ROW THRUST BEARING
SINGLE ROW RADIAL BEARING
IMPELLER AJDUSTING SLEEVE
of high tensile aluminum bronze.
IMPELLER
keyed to shaft and held secure by two heavy jam nuts.
DOUBLE PROTECTION FOR BEARINGS
...synthetic rubber deflector and stainless steel labyrinth.
EXTRA LARGE SHAFT
CATCH BASIN
integral part of pump case.

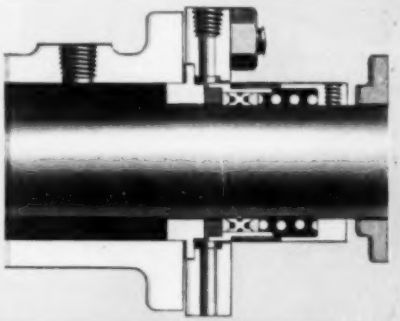
You've asked for them... now BJ introduces these special construction features!

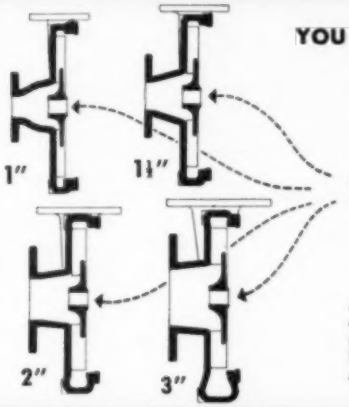
- *Quick and easy dismantling* for inspection and repair without disturbing piping or driver.
- *All parts interchangeable* except pump case and impeller. Four different pump sizes can be used on one basic stuffingbox and bearing bracket assembly.
- *Corrosion-resistant catch basin*—integral part of pump case—guards bearing bracket and base plate from corrosive leakage.
- *Adjusting sleeve* permits compensation for impeller wear—allows easy adjustment without dismantling.
- *Grease lubrication* gives bearings greater protection against acid fumes. Deflector and labyrinth provide double protection against liquid entrance.
- *Cored passages* through impeller web keep stuffingbox under suction pressure.

pumps engineered to your demands...

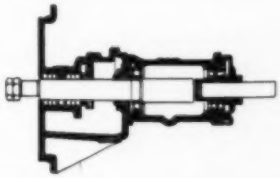
You—the chemical pump user—dictated the design of these new BJ Chemical Pumps. Before Byron Jackson engineered these new BJ models, chemical pump users were asked what features were wanted most. Now these improved features are yours in the new BJ Chemical Pumps. Four pump sizes are available (1", 1½", 2" and 3") with capacities to 450 gpm and heads to 100 feet.

BJ Mechanical Seal also available for protection against leakage. BJ's Type "A" Mechanical Seal is designed especially for the particular demands of chemical pumping. It replaces the packing and provides positive protection against leakage to the bearings or contamination of the pumped liquid. All major parts of this BJ-designed seal are effectively isolated from contact with pumped liquid. Available as special construction, the BJ Mechanical Seal will save you maintenance time and money by eliminating frequent repacking.





YOU BENEFIT FROM MAXIMUM INTERCHANGEABILITY OF PARTS!



All parts except pump case and impeller are *completely* interchangeable. Four different size BJ Chemical Pumps fit one basic assembly! This means that only a few spare parts are needed to service a wide range of pumps.

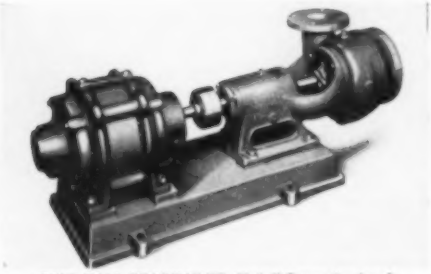
FOR MORE INFORMATION on these new pumps, write BJ Chemical Pump Dept. 4.

BJ makes a complete line of centrifugal pumps to answer your other pumping needs.

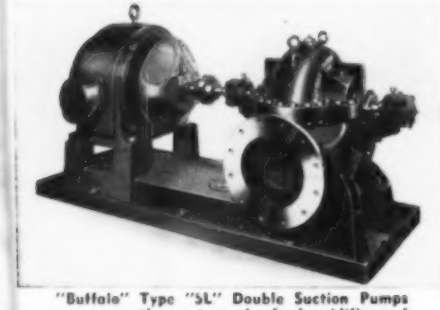
Byron Jackson Co.
Since 1872
P. O. Box 2017 Terminal Annex, Los Angeles 54, Calif.
OFFICES IN PRINCIPAL CITIES

"Buffalo" *Tips on Better Pumping*

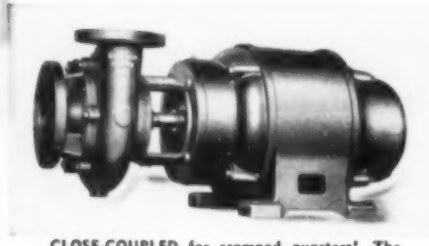
REGULAR PREVENTIVE MAINTENANCE



FULL BALL BEARING "Buffalo" Pump for hard service. Its bearings are oversize, capable of handling speeds up to 5000 rpm.



"Buffalo" Type "5L" Double Suction Pumps are among the most popular for humidifier and air washer service.



CLOSE-COUPLED for cramped quarters! The Type CCL Pump is one of many models to suit specific needs.

Keeps Your Pumps Performing!

• Even the best constructed pumps require regular servicing for efficient performance and long life.

The best way to insure the success of a preventive maintenance program is to set up a regular schedule for servicing and inspection. A qualified engineer who knows pumps and lubricants should be the one to set up this schedule.

The schedule would call for at least four inspections of each pump annually, to check on bearings, shaft alignment, packing, impeller and lubrication. The inspector makes a report of any conditions which need correcting —conditions requiring servicing, to the operating group; conditions requiring repairs, to the maintenance group. (Often, these reports prevent minor conditions from developing into major troubles).

The schedule for lubrication, as well as any operating instructions, should be posted plainly on or near each pump.

This is another in a series of messages by Buffalo Pumps, Inc. in the interest of conserving materials and industrial equipment.

"Buffalo"

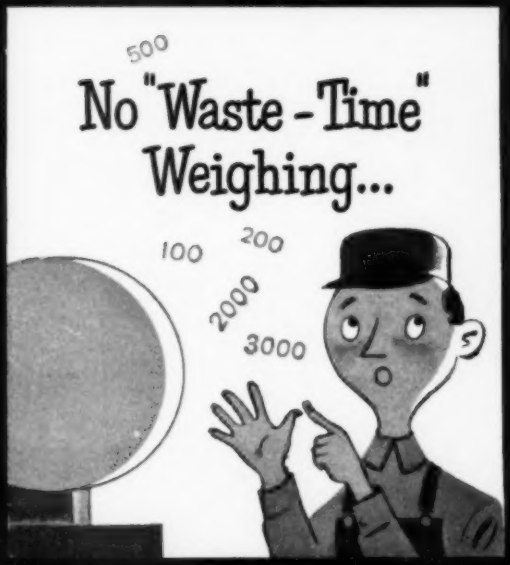
BUFFALO PUMPS INC.

501 BROADWAY, BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



No "Waste-Time" Weighing...

WITH

FAIRBANKS-MORSE

You speed your weighing operations with Fairbanks-Morse Bench Dial Scales. And that means there are no "bottlenecks" to hold up production all through your plant. Here's why:

With Fairbanks-Morse Bench Dial Scales, weights are read right at the point of the indicator. No time-wasting mental calculations are needed. You can weigh as fast as material can be moved on and off the scale platform. And, easy-to-read charts plus elimination of mental calculations reduce the possibility of human error . . . stop profit-eating weighing losses.

To eliminate "waste time" weighing in your operations, consult your Fairbanks-Morse weighing expert. Or, if you prefer, write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

FAIRBANKS-MORSE,

a name worth remembering

SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • PUMPS
HOME WATER SERVICE EQUIPMENT • RAIL CARS • FARM MACHINERY • MAGNETOS

TAKE
A
CLOSER
LOOK

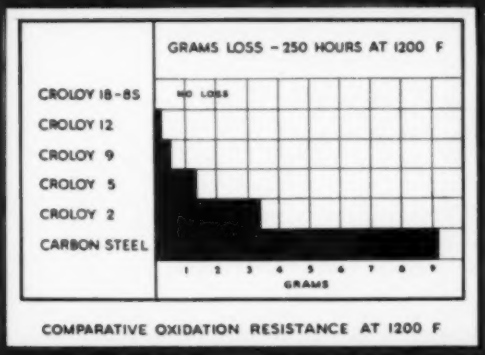
at

OXIDATION

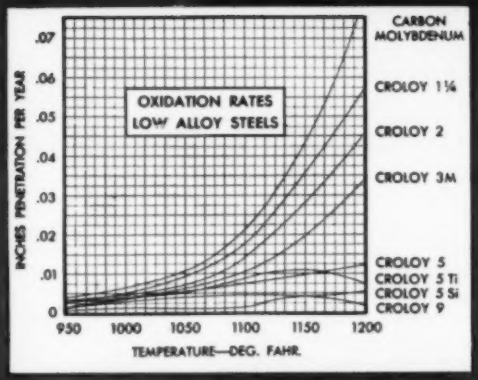
Oxidation is one of the simplest yet most frequently-encountered forms of corrosion affecting the service life of steel tubes in high-temperature applications. When tubes are exposed to elevated temperatures for extended periods of time, scale will form of sufficient thickness to flake off, causing progressive loss of metal. Resistance to oxidation, or scaling, is therefore an important consideration in determining the suitability of tubes for severe temperature conditions.

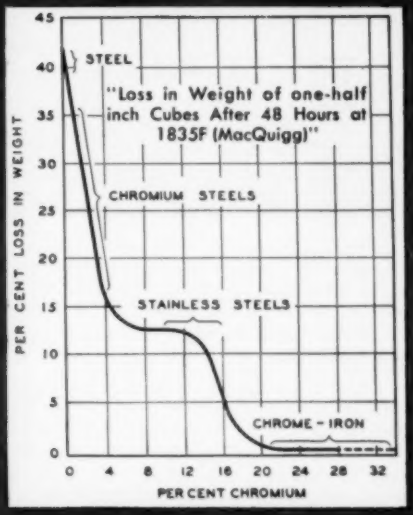
Chromium is the most effective alloying element for providing oxidation resistance in steel tubes. It forms a tight surface layer of chrome-rich oxide which retards inward oxygen diffusion and protects the underlying metal from attack. The amount of chromium required for utmost freedom from excessive scaling is generally in proportion to the temperature conditions to which the tubes will be subjected. Under certain conditions, additional oxidation resistance may be provided by adding small amounts of silicon, titanium, or aluminum.

Tubes of intermediate and stainless B&W CROLOYS are effectively meeting all requirements for oxidation resistance at elevated temperatures in petroleum and chemical processing equipment. Each of these Croloys will provide optimum service life within a definite range of operating conditions. Whenever you have a problem involving oxidation resistance, consult Mr. Tubes—your B&W Tube Representative, and get the benefit of the dependable technical service he represents.



COMPARATIVE OXIDATION RESISTANCE AT 1200 F





THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

General Offices & Plants

Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing

Alliance, Ohio—Welded Carbon Steel Tubing

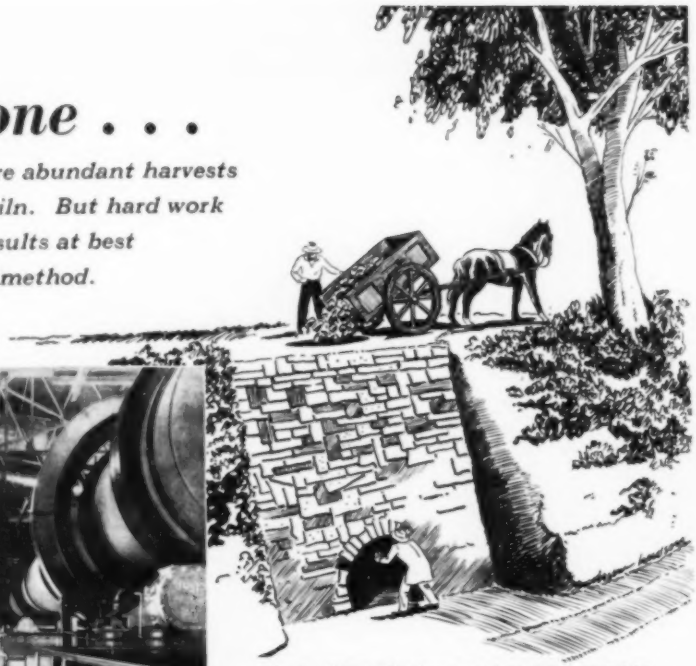
Sales Offices: Beaver Falls, Pa. • Boston 16, Mass. • Chicago 3, Ill. Cleveland 14, Ohio • Denver, Colo. • Detroit 26, Mich. • Houston 2, Texas • Los Angeles 17, Calif. • New York 16, N. Y. • Philadelphia 2, Pa. • St. Louis 1, Mo. • San Francisco 3, Calif. • Syracuse 2, N. Y. Toronto, Ontario • Tulsa 3, Okla.

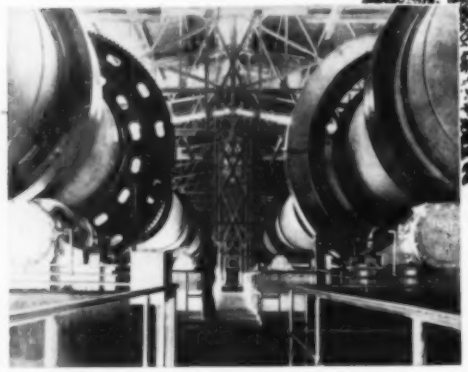
B&W SEAMLESS and WELDED TUBES

TA-1678-5

a milestone . . .

along the road to more abundant harvests is this historic lime kiln. But hard work produced irregular results at best by this old fashioned method.





Traylor Rotary Kilns have earned world-wide regard for the high efficiency and rugged endurance built into them. Each kiln is designed to fit the job it will do. For complete information, ask for Traylor Bulletin 115.

TODAY, scientific farming requires a multitude of agricultural chemicals to rebuild soils and increase crop production. With this need came the demand for more precise methods and machinery for manufacturing fertilizers.

For 50 years, Traylor has played a leading part in the development and production of better machinery for the processing industries. In that time, producers the world over have come to depend on the experience and skill only Traylor can draw upon to provide them with modern equipment for peak performance. They know it's experience that counts. Traylor has experience—half a century of it.

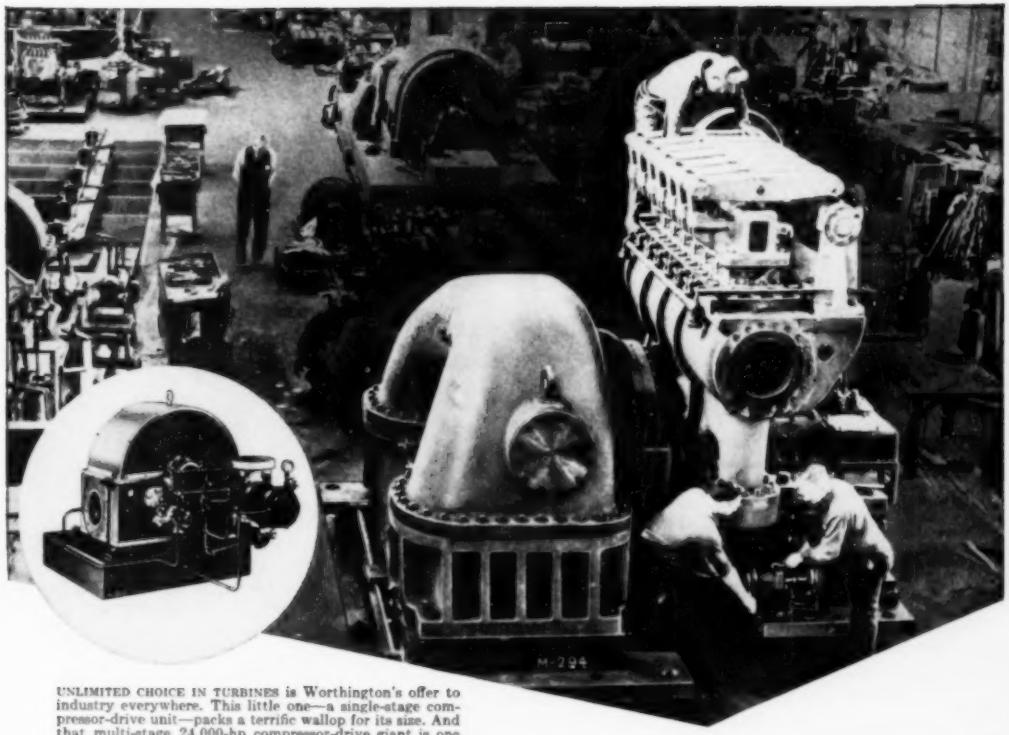
Traylor

ENGINEERING & MANUFACTURING CO.

431 MILL ST., ALLENTOWN, PA.

Sales Offices: New York • Chicago • Los Angeles
Canadian Mfrs: Canadian Vickers, Ltd., Montreal, P. Q.

A TRAYLOR LEADS TO GREATER PROFITS



UNLIMITED CHOICE IN TURBINES is Worthington's offer to industry everywhere. This little one—a single-stage compressor-drive unit—packs a terrific wallop for its size. And that multi-stage 24,000-hp compressor-drive giant is one of the largest ever built for this type of service.

Single-stage midgets to multi-stage giants

Whether your turbine requirements call for the biggest or the smallest—straight condensing . . . straight non-condensing . . . extraction . . . mixed pressure extraction . . . low pressure . . . high back pressure . . . for mechanical or generator drive . . . with governors for constant or variable speed—*Worthington has an answer.*

Each Worthington turbine is designed to make the steam do *more* work, so you save power and money throughout its long life.

Learn more about Worthington turbines. Get the facts on why *there's more worth in Worthington* by writing to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y. T.2.2

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbines

Presenting the NEW SIMPSON

For Faster—Better—Lower Cost Mixing

SIMPSON Mix-Mullers do a *superior* job of material preparation . . . *superior* because these modern machines employ the true mulling principle of controlled mixing. That's why the two new higher capacity SIMPSON Mix-Mullers, the Model 2F and 3F, are so important in solving mixing problems where intimate mixing is vital to the ultimate production of quality products. This increasing need for *intimate* mixing has definitely indicated a trend toward adjustable and increased mulling pressures . . . here featured on the new 2F and 3F Mix-Muller. The results are even faster, better, lower cost mixing than you've ever had before.

The 2F and 3F SIMPSON Mix-Mullers use comparatively light mullers, and employ a unique spring-loaded muller arrangement which allows complete adjustment for all types of material. Because of the advanced design of the 2F and 3F SIMPSON Mix-Mullers, the material to be mixed is subjected to much more *Intensive Mulling* action. Each particle of material is coated with other components of the mix—not merely placed next to each other as is often the case in conventional type mixers. This intimate intensive mulling action prevents segregation after mixing . . . in handling . . . and in transit. Over 300 Simpson Mix-Mullers of this new design have already been thoroughly proved in service . . . your assurance of dependable, low cost operation.

Complete information about the Model 2F and Model 3F SIMPSON Mix-Mullers may be obtained from a National Engineer . . . or by writing for Bulletin 509.

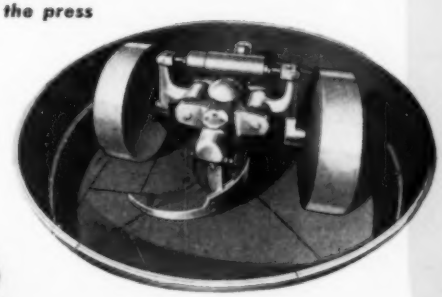
ADVANTAGES

Here are the basic reasons why the new 2F and 3F Simpson Mix-Mullers are the "last word" in modern, scientific mixing.

1. Most thorough mulling action ever developed.
2. Greatest flexibility of operation ever offered.
3. Greater mulling speed—faster discharge.
4. Large batch capacity.
5. Greater uniformity—better batch control.
6. Much simpler, safer operation and maintenance.
7. Less horsepower required.
8. Incorporates all features of rugged construction and intensive mulling principle that have made Simpson Mix-Mullers the standard of the industry for over 30 years.
9. V-belt drive assures maximum flexibility and greater safety factor against sudden overloads.
10. Design backed by years of actual service.

HIGHER CAPACITY 2F and 3F MIX-MULLERS

WRITE FOR BULLETIN 509
. . . Just off the press



DO YOU REALLY KNOW WHAT MULLING IS?

WATCH the practiced technique of a chemist's mortar and pestle—the intensive smearing and rubbing actions—and basically *THAT'S MULLING.* Nothing compares with it in uniformly blending dry, semi-dry or pasty materials.

It is this process which develops the full potential qualities of the material through the "working and kneading" action. Obviously the best muller pressure-area ratio is that which will act upon the greatest number of grains per revolution of the muller. In the 2F and 3F Simpson Mix-Muller the ideal action is obtained by adjusting the muller pressure for the material being mixed. High unit pressure acting throughout a deep bed of material, the most effective condition, is obtained with the new muller design and the heavy compression spring.

SIMPSON *MIX-MULLER* DIVISION
NATIONAL ENGINEERING CO., 600 Machinery Hall Bldg., Chicago 6, Ill.

look to

TRI-CLOVER

for the best in
Stainless Steel
CORROSION-RESISTANT

FITTINGS · PIPE TUBING · PUMPS and CUSTOM FABRICATION

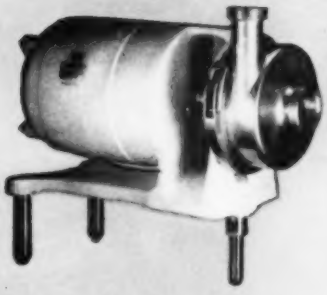
CONICAL END FITTINGS

Fabricated in Stainless Steel Type 316 and other SS analyses. A complete line of ells, tees, crosses, laterals, reducers, etc., in sizes from 1 in. O.D. thru 4 in. O.D. Features: Light weight—low cost—simple, fast installation—leak-tight—sturdy flanges of all types for every application—easily adapted to all other fitting types. Fully annealed and passivated. *(Illustrations show a 90° sweep ell and a conical-end tee flanged to standard I.P.S. threaded adapter.)*

SANITARY FITTINGS TUBING and PIPE

Tri-Clover "sanitary" type stainless steel fittings are available in sizes from 1 in. thru 4 in. O.D., in a full range of fitting types. Designated and approved as meeting 3-A Standards throughout, incorporating numerous exclusive design and construction features that assure highest quality.

A full line of stainless steel tubing and pipe is available for all corrosion-resistant needs in sizes from 1 in. thru 4 in. O.D.



INDUSTRIAL and SANITARY PUMPS

Tri-Clover offers a full line of centrifugal pumps for handling clear liquids, heavy liquids and semi-solids of all types, for use on sanitary lines in food, dairy and beverage industries — and for general industrial corrosion-resistant service. Capacities from 10 to 1250 gallons per minute.

Zephyrweld® WELDING FITTINGS

Fabricated in Stainless Steel Type 304, 347, 316 and other SS analyses. Fabricated in I.P.S. and O.D. Tube Size from ½ in. thru 36 in.—in ells, tees, crosses, welding nipples, flanges, adapters, etc. Features: Streamlined, sweep ell construction; free-flow; light weight; fully annealed and passivated. A high quality fitting widely used in broad chemical process use.

® Trade Mark Registered

RECESSED-END FITTINGS

Fabricated in Stainless Steel Types 304, 347 and 316. Here are low cost, light weight, high quality fittings designed for fast, simple soldering, brazing or socket welding. Available in sizes for an extremely wide range of applications, ranging from ⅜ in. thru 24 in. Full line of elbows, return bends, tees, crosses, adapters, etc. Fully annealed and passivated.

CUSTOM FABRICATION

When it comes to expert welding and fabricating of complex custom assemblies, you just can't beat the speed and accuracy offered with TRI-CLOVER'S exclusive Heli-Arc Atomic Hydrogen Welding . . . a specialized semi-automatic process that assures highest quality and FULL corrosion resistance (Shown are two examples of the type of "special" jobs we handle every day).

ILLUSTRATED here are some of the types of stainless steel fittings, pumps, tubing, pipe and custom fabrication that are included in the *complete* Tri-Clover line of corrosion-resistant liquid conveying line materials.

Tri-Clover fittings are truly quality fittings. To assure the highest possible degree of corrosion, resistance, all industrial fittings are fully annealed and passivated after fabrication. Modern, precision fabrication to close tolerances precludes any need for reworking during installation.

By installing these stainless steel products in your process lines, you will realize the advantages of increased production and lower maintenance costs. Over 30 years of specialized engineering service is at your disposal in helping to solve your specific corrosion-resistant piping problems.

Write for details, or see your nearest Tri-Clover Jobber.

I-352

Tri-Clover®
MACHINE CO.
Kenosha, Wisconsin

TRIALLOY AND STAINLESS STEEL SANITARY FITTINGS, VALVES, PUMPS, TUBING, SPECIALTIES

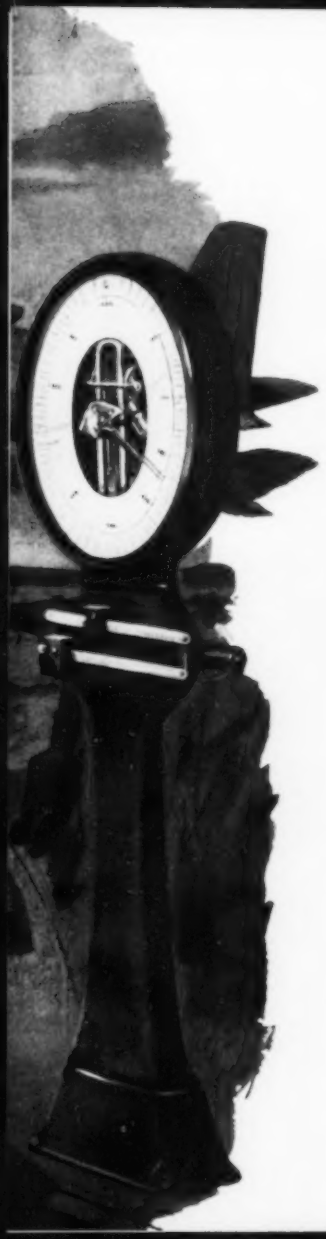
FABRICATED STAINLESS STEEL INDUSTRIAL FITTINGS AND INDUSTRIAL PUMPS

THE Complete LINE

(This advertisement originally appeared in full-color in TIME, BUSINESS WEEK and FORTUNE.)

SERVING INDUSTRY . . . SERVING AMERICA

You are always close to Continental Can with its 65 plants in the United States, Canada and Cuba, 17 field research laboratories and 63 sales offices.



THE STORY OF DRUMS THAT ARE BETTER IN EVERY WEIGH

Some containers for shipping bulk materials weigh almost as much as their contents. Although they give good protection, they run up shipping costs, particularly when products are moving air express or overseas.

Continental gave this situation a lot of study and today offers a variety of fibre drums which combine full product protection with light weight—and that's sweet music to any shipper.

These containers can carry up to forty times their own weight. The secret of their strength is *resiliency*. An accidental fall or bump that might shatter a rigid container only bends the flexible walls of a Continental drum.

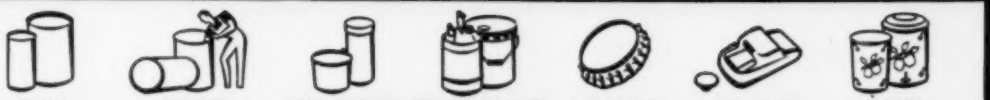
Right now, Continental fibre drums are being used to ship hundreds of materials for both civilian and defense use. Included are chemicals of all kinds, such as resins, plastics, intermediates, detergents, dyestuffs and pharmaceuticals; also many powdered and dehydrated foods.

Like most Continental products, our fibre drums are the result of a long period of development and improvement. Continental chemists found better ways of laminating kraft paper for extra strength. Continental engineers developed better closures. Most recently, special linings for "difficult" products, such as wet or greasy materials, have been devised. This research work on drums is typical of Continental's never-ending search for better materials, designs and methods.

CONTINENTAL CAN COMPANY

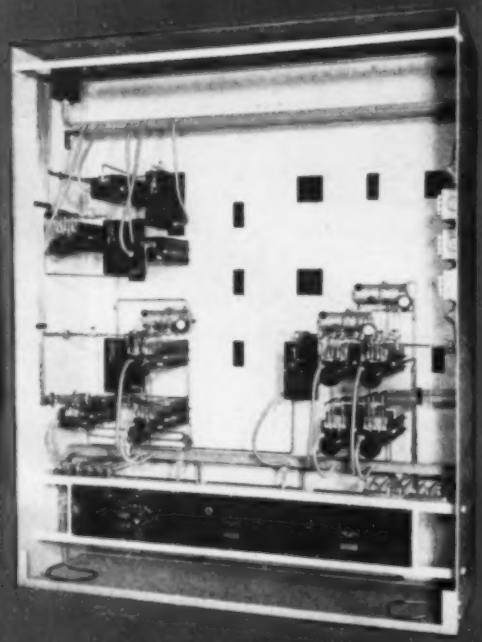
CONTINENTAL CAN BUILDING

100 E. 42nd ST., NEW YORK 17, N. Y.

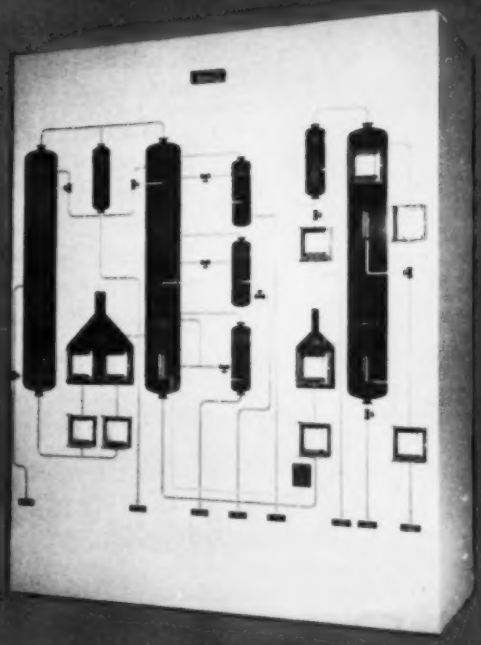


Graphic panels for your process control...

engineered and custom-built by Honeywell



Rear view of the panel shows completeness and skilled workmanship of Honeywell factory assembly. Tel-O-Set Controllers are fully piped to recorders. Electronic temperature transmitters are mounted in the rack at the bottom. Panel cut-outs are provided for future instruments.



This Honeywell ColorGrafic panel for a continuous process represents graphically each major process, identifies process streams by means of colored flow lines. Level indicators and Tel-O-Set recorders are mounted on the diagram at points of measurement and control.

Honeywell Instrumentation includes:

TEL-O-SET MINIATURE RECORDERS, INDICATORS AND CONTROLLERS

Specifically designed for graphic panel use, the Tel-O-Set family of instruments packs a lot of performance and quality into space-saving construction.

TEL-O-SET RECORDER:

Mounts on six-inch centers. Provides a continuous record of process variable. All adjustments are accessible from front of panel. By means of a knob and switches, the control air pressure loading and set point can be obtained, or an operator can switch from automatic to manual operation and back to automatic without upsetting the process.

TEL-O-SET CONTROLLER:

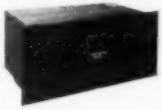
Available in a variety of models with fixed or adjustable proportional band, fast or slow reset rate, with or without bypass relay. Offers economy of selection, for control of process variables such as flow, temperature, and pressure.

TEL-O-SET INDICATOR:

A compact circular-dial indicator for displaying the measured value where continuous recording is not required. Fits same size panel cutout and has same pneumatic switching arrangements as Tel-O-Set Recorder.

LIQUID LEVEL INDICATOR:

Compact and rugged, this vertical-scale instrument indicates liquid level continuously. Easily-read scale needs no external illumination.



ELECTRONIC PNEUMATIC TEMPERATURE TRANSMITTER

This transmitter converts the electrical signal from a thermocouple into a variable air pressure which is transmitted to Tel-O-Set instruments. It uses the performance-proved components of *ElectroniK* instruments. Compact, readily mounted behind the panel.

GRAPHIC PANELS—nerve centers of modern processing units—are setting new high standards for convenience and efficiency in process control. And, you profit fully by centralization when you take advantage of the functional design and instrumentation of ColorGrafic panels by Honeywell. Here are some of their outstanding features:

Broad selection of instruments: A full line of indicators, recorders and controllers . . . both miniature units for incorporation in the process diagram, and conventional units for supplementary detailed data. Equipment covers all process variables . . . including sensing elements, remote transmitters and control valves.

Complete panel engineering and construction facilities: Honeywell engineers, working in close cooperation with your staff, design integrated panels for the specific requirements of your individual process. The control boards are assembled in Honeywell's extensive panel shop, then are shipped complete, with all instruments in place, fully wired, piped and tested . . . ready to connect to plant equipment. You save substantially . . . in engineering and installation time.

Your local Honeywell engineer will be glad to discuss how ColorGrafic panels can be applied to your processes. Call him in today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4478 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

First in Controls

- *Important Reference Data*

Write for Bulletin No. 85-20, "Centralized Instrumentation . . . unlimited."

Your own test proves

AMPCO*
ALUMINUM BRONZES

Typical Applications in which Ampco Alloys have been used with Cost-Saving Success!

Absorption columns
Acetylators
Acid chain
Agitators
Autoclaves
Baskets
Bearings
Beater bars
Bellows
Bolts and nuts
Brazing rod
Brine coils
Bubble caps and trays
Calandrias
Condenser shells
Condenser tubes
Condenser tube sheets
Control valves
Conveyors
Coolers
Crystallizers
Dephlegmators
Digesters
Ejectors
Evaporators
Evaporator tubes
Extractors
Fabricated assemblies
Filters and filter screens
Filter presses
Fittings — forged, cast
Forgings
Fractionating columns
Hangers
Heat exchangers
Heater coils
Hooks
Injectors
Instrument cases and elements
Kettles
Line hardware
Meter cases
Mixers
Pans, evaporator
Perforated plate
Pickling baskets
Pipe and fittings
Plug cocks
Pressure vessels
Pumps
Reboilers
Retorts
Rivets
Safety tools
Screens
Screws, conveyor
Sludge burners
Springs
Stills
Studs
Sucker rod
Tanks
Tools, safety
Towers
Trays, fractionating
Tubes and tubing
Vats
Valves
Welding rod
Wall tubing
Wire
Woven wire cloth

Chemical Agents and the Applicability of AMPCO Alloys

Acetate Solvents (Pure)	E	Carbon Dioxide		Hydrogen Sulfide		Potash Crudes	E	Toluene or Toluol	E
Crude	G	Dry	E	Wet	NR	Propane	E	Tri Chloroethylene	E
Acetic Acid		Wet	G	Dry	F	Shellac	E	Tri Sodium Phosphate	E
Crude	E	Carbon Disulfide	F	Lacquers and Lacquer Solvents	E	Soaps	E	Turpentine	E
Vapors	E	Carbon Tetrachloride	E	Lactic Acid	G	Soda Ash (Sodium Carbonate)	G	Varnish	E
Acetic Anhydride	G	Caustic Soda	E	Magnesium Chloride	G	Sodium Bicarbonate	G	Vegetable Oils	E
Acetone	E	Chlorine		Magnesium Hydroxide	E	Sodium Bisulfate	E	Water	
Acetylene	NR	Dry	G	Magnesium Sulfate	E	Sodium Carbonate	E	Fresh	E
Alcohols	E	Wet	NR	Malt Beverages	E	Sodium Chloride	E	Salt (includes Polluted Harbor)	E
Aluminum Fluoride	G	Chloroform	E	Mercuric Chloride	NR	Sodium Cyanide	NR	Xylene	E
Aluminum Sulfate	E	Chromic Acid	NR	Mine Water (Sulfate)	E	Sodium Hydroxide	E	Zinc Chloride	G
Aluminum Hydroxide	E	Citric Acid	E	Molasses	E	Sodium Nitrate	E	Zinc Sulfate	E
Ammonia Gas		Copper Sulfate	NR	Monochlorobenzene	E	Sodium Perborate	E		
Dry	G	Crude Oils — Sour	G	Muriatic — Cold, Commercial	G	Sodium Peroxide	E		
Wet	NR	Esters	E	Naptha	E	Sodium Phosphate			
Ammonium Chloride	NR	Ethers	E	Natural Gas	E	Alkaline	E		
Ammonium Hydroxide	NR	Ethylene Glycol	E	Nickel Chloride	G	Neutral	E		
Ammonium Nitrate	F	Ethyl Sulfate	E	Nickel Sulfate	G	Acid	E		
Ammonium Phosphate	E	Ferric Chloride	NR	Nitric Acid	NR	Sodium Silicate	E		
Ammonium Sulfate	E	Ferric Sulfate	NR	Nitrogen (Dry)	E	Sodium Sulfate	E		
Amyl Chlorides	E	Formaldehyde	E	Oleic Acid	E	(Soda Cake)	E		
Asphalt	E	Formic Acid	E	Oxygen	E	Sodium Sulfide	NR		
Barium Chloride	G	Freon	E	Paint Vehicles (Except Soya-Oil)	G	Sulfur	F		
Beer	E	Furfural	E	Palmitic Acid	G	Sulfur Chloride	NR		
Beet Sugar Liquors	E	Gasoline	E	Petroleum Oils		Sulfur Dioxide			
Benzene or Benzol	E	Gelatine	E	Sour	G	Dry	G		
Boron	E	Glucose	E	Refined	E	Wet	G		
Boric Acid	E	Glycerine	E	Phenol	E	Sulfuric Acid			
Brine	E	Hydrocarbon Gases	E	Phosphoric Acid	E	5%	E		
Butane, Butylene	E	Hydrochloric Acid		Pickling Acid (except Nitric Chromic)	E	10%	E		
Butadiene	E	to 5%	G	Potassium Chloride	E	Up to Boiling 25%	E		
Butyric Acid	E	to 10%	F	Potassium Cyanide	NR	35%	E		
Calcium Bisulfite	G	(see Muriatic)		Potassium Hydroxide	F	50%	E		
Calcium Hydroxide	G	Hydrocyanic Acid	NR	Potassium Sulfate	E	Sulfuric Acid Sludge	G		
Calcium Hypochlorite	F	Hydrofluoric Acid	E			Sulfurous Acid	G		
Cane Sugar Liquors	E	Hydrogen Fluoride (Dry)	E			Tannic Acid	E		
Carbolic Acid	E	Hydrogen	E			Tartaric Acid	E		
		Hydrogen Peroxide	F						

These ratings may usually be interpreted as follows:

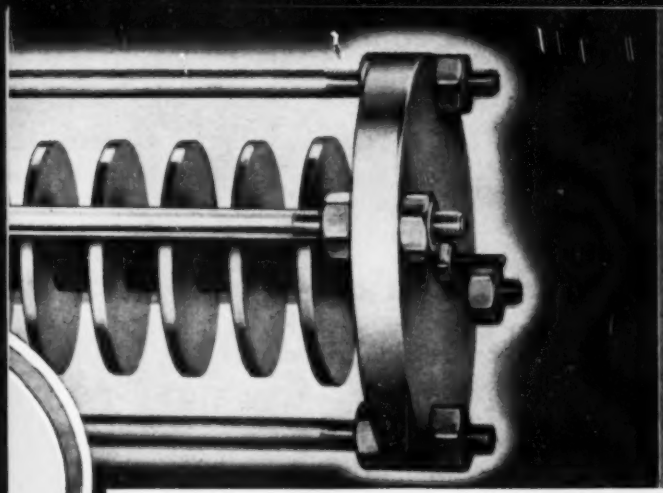
E — Excellent
IPY Penetration $<0.008"$

G — Good
IPY Penetration $<0.016"$

F — Fair
IPY Penetration $<0.050"$

NR — Not Recommended
IPY Penetration Over $0.050"$

In using this data, it should be understood that these are results of specific tests and are indicative of those conditions under which the tests were run, and are a basis for recommendation, but not for guarantee.



Fabricating Ampco Metal with Inert Gas [illegible] Electrode Welding.

are a Practical Remedy for Your Corrosion Ailments

The success of Ampco aluminum bronzes in solving many different corrosion problems for a wide variety of applications is quickly evident from a glance at the tables on the opposite page.

But you may have a special problem of your own. You may want to make your own tests — prove to yourself that Ampco aluminum bronzes offer a money-saving solution.

Here's all you have to do: We have a complete stock of test specimens of different materials which can be mounted on racks. Several forms of racks are available for tests in atmospheric locations, pipe lines, tanks or other pressure vessels. Just write and ask for test specimens, but be sure to outline the conditions under which the test is to be conducted so that we can supply the most suitable form.

Here's another service that can help you. Sometimes repeated 60- to 90-day exposures are required. Our own technicians will work with you through the testing period, pilot plant and preplant operations. Write today.

Ampco Plug Valves

Ampco Bronze Electrodes

Ampco Pipe Fittings

*Reg. U. S. Pat. Off.

Tear out this coupon and mail today!

Ampco Metal, Inc.
Milwaukee 46, Wisconsin
West Coast Plant,
Burbank, California

AMPCO

AMPCO METAL, INC., Dept. CE-4, Milwaukee 46, Wisconsin

Send me information on the application of Ampco Aluminum Bronzes for corrosion-resistant service in the Process Industries.

Name..... Title.....

Company.....

Company Address.....

City..... (.....) State.....

PR-6

make your own comparison...

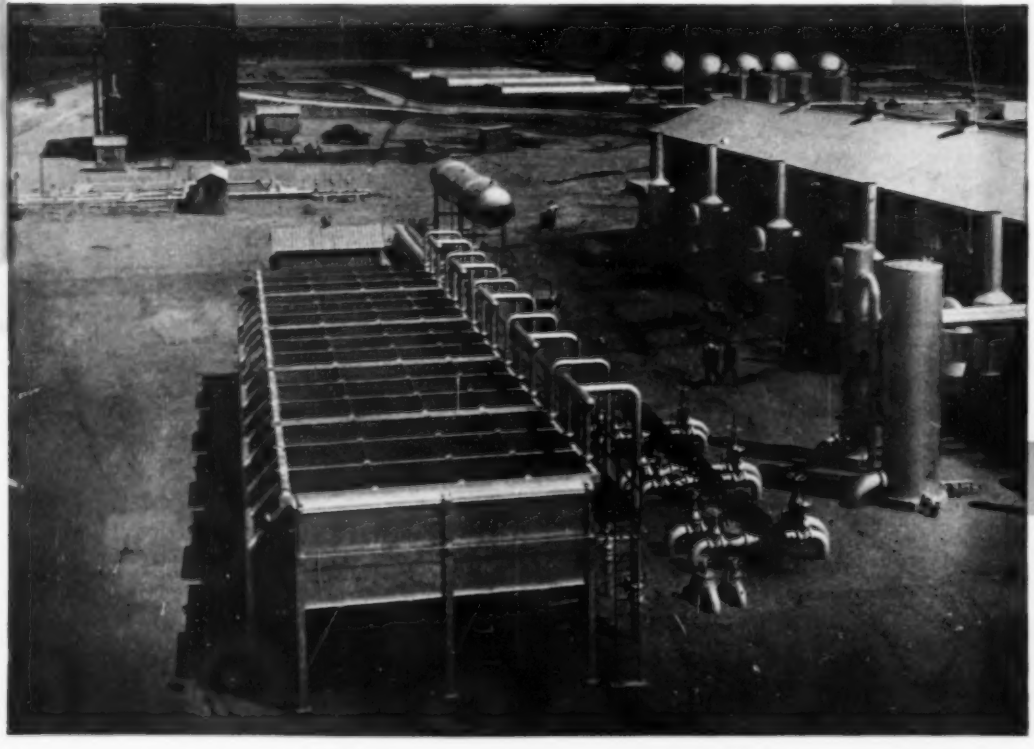
a Fluor-GR Fin-Fan

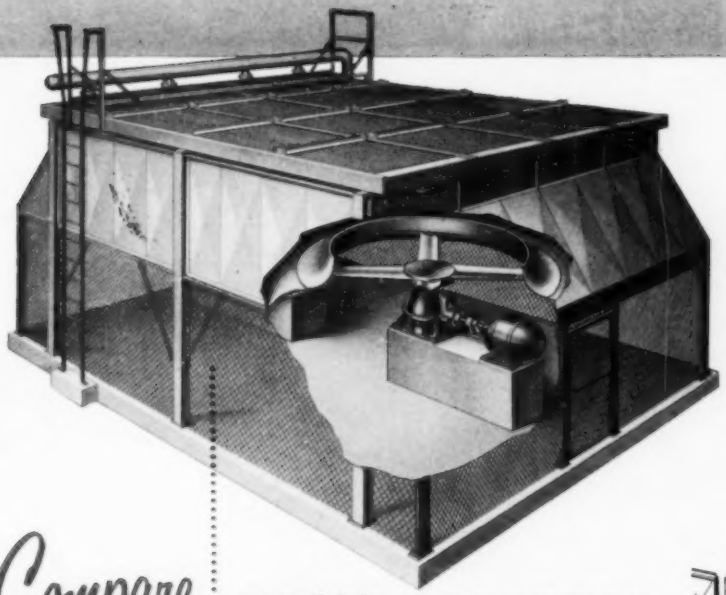
against any other air-cooled heat exchanger

When considering air-cooled heat exchanger equipment, compare the advantages of a Fluor-GR Fin-Fan. Make comparisons of structural simplicity and flexibility. Compare the exclusive features of the K-Fin section, the rugged yet precision design of all mechanical equipment. Check *proven performance* in such varied services as gas transmission systems, petroleum refineries, light hydrocarbon processing plants, chemical processing plants, and power and industrial plants.

The Fluor-GR Fin-Fan was *pioneered* by The Fluor Corporation and the Griscom-Russell Company. It was the *first* of this type heat exchanger to be developed for industry. Fluor, with its wide experience in the theory, design, and fabrication of air-moving systems, and Griscom-Russell, with its long experience in heat transfer, *continue* to lead in the development and refinement of air-cooled heat exchanger equipment.

Before you buy or specify, compare the Fluor-GR Fin-Fan. A Fin-Fan provides more exclusive design features—features that add up to *efficient, dependable* performance —than any other make of air-cooled heat exchanger. Write for Fluor Bulletin No. FF-8501.



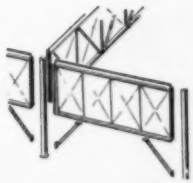


Compare

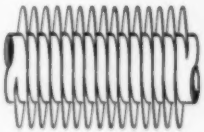
Compare

Compare

structural design – Structurally, the Fin-Fan is the ultimate in simplicity and flexibility. Its "truss-type" design provides a rugged, vibrationless unit, free of extraneous parts. Uniform prefabrication of parts, with bolt holes and orientation *incorporated* in basic design, permits easy extension without shut-down of existing units!



K-Fin features – G-R K-Fins are tension-wound for *moderate* temperatures, rolled into grooves for *elevated* temperatures. Threaded header plugs provide quick, easy access to tube ends for cleaning or replacement. Plugs are shoulder-tight to form a leakproof metal-to-metal joint at all pressures, independent of thread tightness.



mechanical equipment – Fluor mechanical equipment is ruggedly designed to meet specific heat transfer requirements. 4 basic gear units cover 4 different and distinct horsepower ranges. This, coupled with a choice of fan assemblies ranging from 8′ to 20′ in diameter, with 4 or 6 blades per fan unit, enables the *proper* combination of gears and fans to effect optimum efficiency.

Compare

proven performance . . .

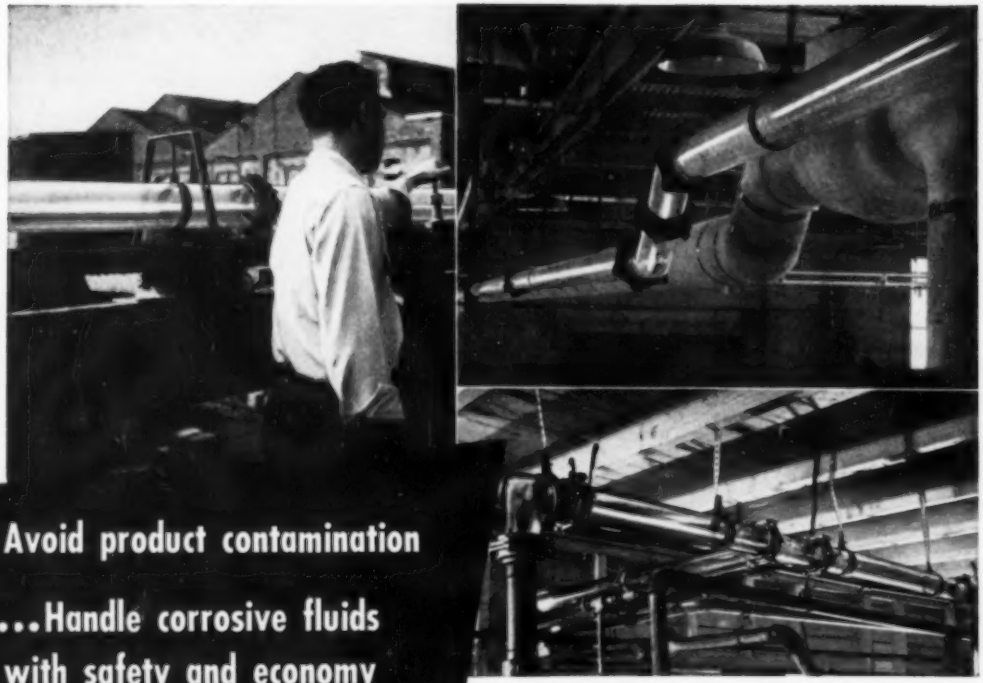
More Fluor-GR Fin-Fan Air-Cooled Heat Exchangers are in service throughout the continental United States and in countries abroad than any other make. More Fluor-GR Fin-Fan installations are the result of repeat orders than any other type. Check with your nearest Fluor Representative for the Fin-Fan's outstanding record of proven performance – in services and duties similar to your own!

FLUOR

Engineers - Constructors - Manufacturers

THE FLUOR CORPORATION, LTD., 2500 S. ATLANTIC BLVD., LOS ANGELES 22, CALIF.
New York, Chicago, Pittsburgh, Boston, Tulsa, Houston, San Francisco, Birmingham and Calgary

Represented in the Sterling areas by:
Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.1., England



Avoid product contamination

...Handle corrosive fluids with safety and economy

use PYREX® "DOUBLE-TOUGH" brand

PYREX brand Glass Pipe is chemically stable, corrosion and heat resistant, transparent, strong; and it can be plumbed at your plant

The head of engineering in a plant manufacturing vitamins says:

"We have selected PYREX pipe to avoid contamination of the product and for its corrosion resistance. Also because of its transparency. In our extraction process, we have to see what's going on.

"We must be particularly careful that no metal particles or salts contaminate our product. Metal is not necessarily recognizable in the product by taste reaction; but it may act as a catalyst, upsetting the chemical reaction which we are producing.

EASY TO INSTALL "When you first go into PYREX piping installations, you may need service from the distributor, but with the proper direction our own men can now handle the equipment very satisfactorily."

NOW STRONGER THAN EVER The new PYREX brand "Double-Tough" Glass Pipe is easy to handle. It's made from heavy-wall machine-drawn tubing. A new heat treating process doubles the strength of the ends of standard flanges and fittings, where applied stresses are greatest. Experience with it will prove that breakage is no problem.

PYREX

CORNING GLASS WORKS, CORNING, N. Y.

Corning means research in Glass

PYREX PIPE IS ECONOMICAL The low first cost, easy installation, and long time corrosion resistance of PYREX pipe combine to make it one of the most economical types of process pipe available.

CONVENIENTLY LOCATED DISTRIBUTORS carry full stocks of all popular sizes of PYREX Brand "Double-Tough" Glass Pipe.

The one nearest you can help you with layouts and installation.

A. J. Eckert Company
Albany 5, New York

Glass Engineering Laboratories
Belmont, California

Macalaster Bicknell Company
Cambridge 39, Massachusetts

Fred S. Hickey, Inc.
Chicago 44, Illinois

Valley Foundry & Machine Works
Fresno 17, California

Sentinel Glass Company
Hatboro, Pennsylvania

W. H. Curtin Company
Houston 7, Texas

Fisher Scientific Company
Pittsburgh, Pa.

Fisher Scientific Company
Montreal 3, Quebec, Canada

Scientific Supplies
Seattle 4, Washington

Stammarich Supply Inc.
St. Louis 2, Missouri

Mooney Bros. Corp.
Lodi, New Jersey

Will Corporation
Rochester 3, New York

AVAILABILITY PYREX Brand "Double-Tough" Glass Pipe is available in diameters of 1", 1½", 2", 3", 4", and 6" I.D. in standard lengths up to 10 feet. Fittings, including 45° and 90° elbows, tees, reducers, crosses are also available in 1" to 4" sizes. Plug valves are available in 1" and 1½" sizes. *Send for catalog.*

Glass Pipe

"DOUBLE-TOUGH" GLASS PIPE AND FITTINGS are made of the same PYREX brand glass used for PYREX brand laboratory ware. It is corrosion resistant to all chemicals and chemical combinations except hydrofluoric acid, phosphoric acid with traces of fluorides, and hot concentrated alkalis. The following data indicate its high chemical stability and heat resistance:

Loss in weight: 5% HCL for 72 hours at 80° C.—.000002 grams per sq. cm.

Specific heat: 0.20 BTU/lbs. per °F.

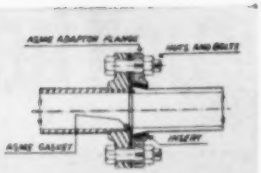
Thermal Conductivity: .67 BTU/hr. x ft.² x °F. per ft.

Linear coefficient of expansion: .0000018 per °F. between 32 and 572°F.

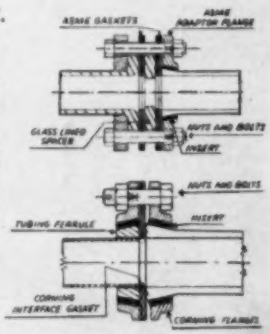
Maximum safe operating temperature: 450°F. for piping.

VISIT THE NEW CORNING GLASS CENTER

How to handle PYREX brand Glass Pipe with ease and economy



INSTALLATION IN YOUR PLANT. Pages 10 to 12 of the new PYREX Pipe Installation Manual illustrate step by step the simple operations involved in plumbing PYREX Pipe in the field. Any mechanic or pipe-fitter can handle the usual requirements with a little practice, such as making field flanges or compensating for slight measuring errors or changes in original layouts with adjustable joints or spacers.



HOW TO CONNECT PYREX BRAND GLASS PIPE TO OTHER MATERIALS You'll find it no problem to connect PYREX Pipe to any other standard pipe material, valve, or tank nozzle. For instance, in connecting to standard sanitary metal tubing, you simply braze or silver-solder a stainless steel tubing ferrule to the metal tubing and assemble as described above. See the details on page 9 in the Installation Manual.

PYREX BRAND CASCADE COOLERS are an ideal solution for cooling corrosive chemicals or liquids susceptible to contamination. Special thin-walled tubing with heat treated ends permits maximum heat transfer. These easily assembled, complete units provide low first cost heat exchange plus minimum maintenance. For complete details check coupon below.

CORNING GLASS WORKS, Dept. CE-4, Corning, N. Y.

Please send me the printed information checked below:

NAME

TITLE

COMPANY

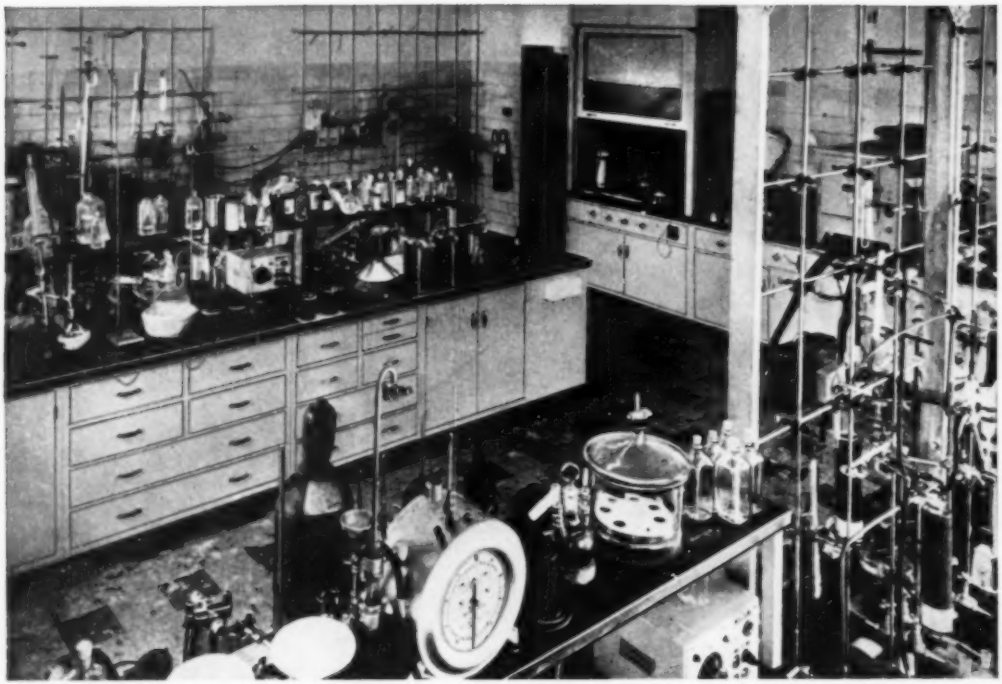
STREET

CITY

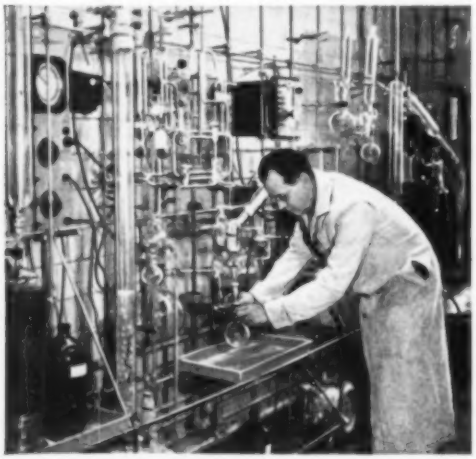
ZONE STATE

- ☐ "PYREX brand Glass Pipe in the Process Industries" (EA-1)
- ☐ "PYREX brand "Double-Tough" Glass Pipe and Fittings" (EA-3)
- ☐ "Plant Equipment Glassware for Process Industries" (EB-1)
- ☐ "Installation Manual" for PYREX brand "Double-Tough" Glass Pipe (PE-3)
- ☐ "PYREX Cascade Coolers" (PE-8)

These Great Laboratory



PETROCHEMICALS offer independent inventors great opportunity for exploration and reward. Such synthetics as Nylon, Vinylite, Neolite are already indispensable to our expanding economy—and new ideas in this area are at a premium today.



UNDER THE SINCLAIR PLAN, chemistry laboratories like these are open for the first time to independent inventors.

ELECTRON MICROSCOPE, capable of magnifying 100,000 times, is typical of the expensive equipment now available.

Facilities Are Open to You

Many inventive people have responded to the Sinclair Plan's offer of laboratory facilities — to others who wish to do so, a suggestion: There is promise and profit in oil-based synthetics.

EIGHT months ago, Sinclair turned over a part of its great laboratories at Harvey, Illinois, to independent inventors who had promising ideas in the field of petroleum products but who did not have the facilities needed to develop or prove out their ideas.

To date nearly 5,000 people have submitted ideas to the laboratories, and the Plan is recognized as a valuable service to independent inventors. As a result we have made the Sinclair Plan part and parcel of the long-range operation of our company.

There may be inventive people interested in this Plan but wondering what sort of ideas or what areas would be profitable to explore. To those people we suggest the field of petrochemicals. Such things as plastics, synthetics, substitutes and new materials as yet undeveloped—made from petroleum—offer great opportunities for invention and reward.

If you have an idea of this sort—or in the general area of petroleum products or applications—you are invited to submit it to the Sinclair Research Laboratories. In your own interest, each idea must first be protected by a patent application or a patent.

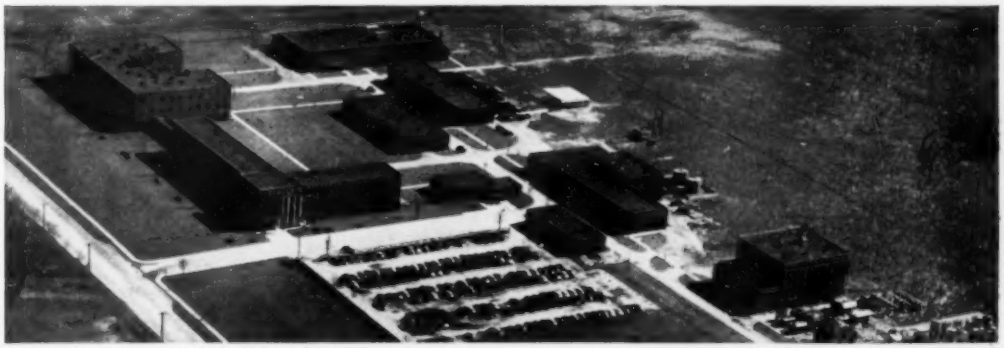
The inventor's idea remains his own property

If the laboratories select your idea, they will make a very simple arrangement with you: In return for the laboratories' work, Sinclair will receive the privilege of using the idea for its own companies, free from royalties.

This agreement in no way hinders the inventor from selling his idea to any of the hundreds of other oil companies for whatever he can get. Sinclair has no control over the inventor's sale of his idea to others, and has no participation in any of the inventor's profits.

HOW TO PARTICIPATE: Instructions are contained in an Inventor's Booklet available on request. Write to: W. M. Flowers, Executive Vice-President, Sinclair Research Laboratories, Inc., 600 Fifth Avenue, New York 20, N. Y.

IMPORTANT: *Please do not send in any ideas until you have sent for and received the instructions.*



SINCLAIR RESEARCH LABORATORIES—nine buildings containing the most modern testing equipment known—have contributed many of today's most important developments in petroleum. Under the Sinclair Plan, the available capacity of these great laboratories is being turned over to work on the promising ideas of independent inventors everywhere.

SINCLAIR—for Progress

HUDSON
MULTI-WALL SACKS

PASTED AND SEWN—VALVE AND OPEN MOUTH

MEASURE UP TO YOUR MOST EXACTING SPECIFICATIONS

Hudson is able to deliver multi-wall sacks that live up to the letter of your specifications...*every time*. Here are the reasons:

1 Hudson has control over all the basic ingredients. Every step in manufacture—from the timber reserves to the finished sack—is under one ownership and management.

2 The Hudson mill is new. Here the most modern equipment that can be built turns out your sacks under regulated temperature and humidity. Electronic controls give a new meaning to the word "exact."

3 Tests, inspections, and double checks follow your sacks through the mill, with a relentless vigil.

4 Hudson is a veteran of 30 years of experience in the kraft field. The company understands your problems in packaging and knows why your specifications are *important*.

Order from Hudson, and be sure of sacks *when* you want them —the *way* you want them!

This young lady is making one of a series of detailed inspections that follow your multi-wall sack through the Hudson mill. It is just one of the assurances that every sack shipped to you is up to specifications.

Send today for informative literature on Hudson Multi-Wall Sacks. Just drop us a note.

a completely integrated mill

HUDSON PULP AND PAPER CORPORATION

Dept. 133. 505 Park Avenue, New York 22, N.Y.

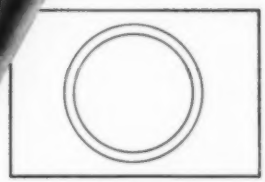
Will the years say "STOP" to your PROCESS LINES?

Why take a chance with process lines that clog with rust? Chase® Copper Water Tube has *proved* its corrosion-resistant, non-rusting qualities.

Even heavy industrial fluids like paper pulp flow freely through Chase Copper Water Tube. Its smooth interior surface offers little resistance.

Chase Wrought Solder-Joint Fittings are pressure-tight and leak-proof. That's why they're ideal for process gases and refrigeration.

It will pay you to inquire about lightweight, easy-to-install Chase Copper Water Tube for your next process line installation.



Even after Chase Copper Water Tube carried pulp fluids in a paper mill year after year the cross-section still looks like this.

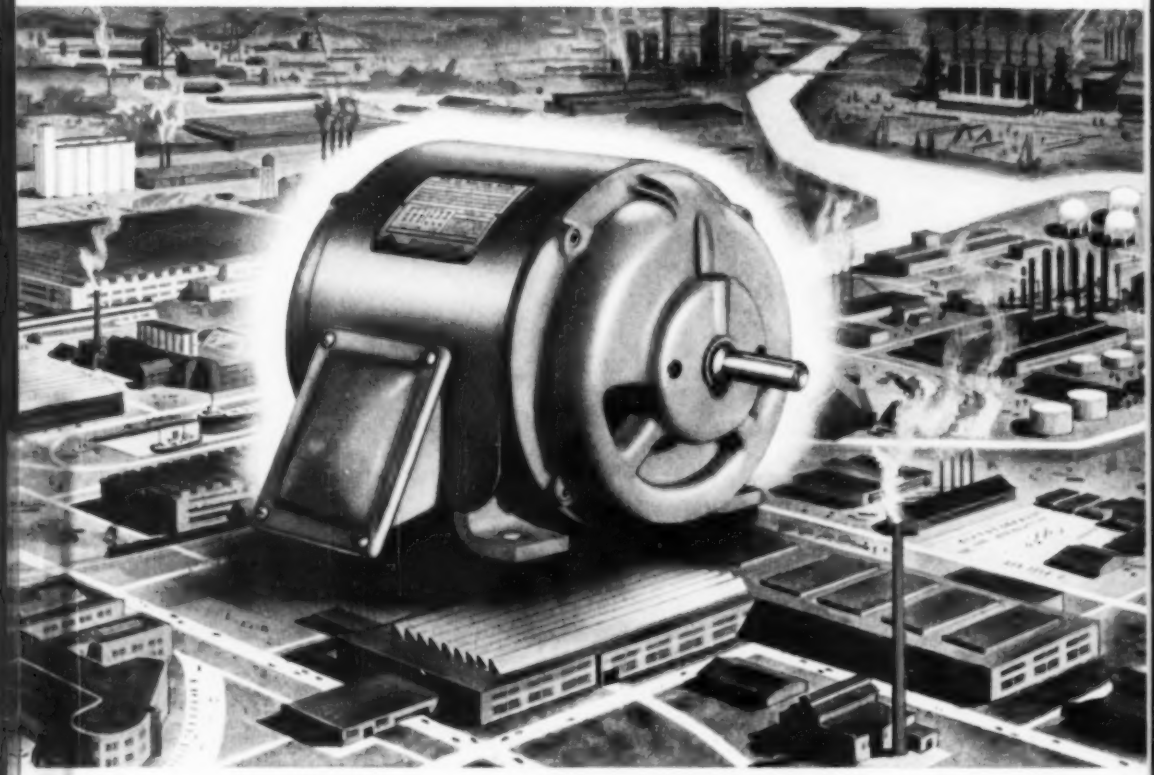
Why gamble with pipe that can rust up inside . . . impede flow . . . increase pumping costs. Use Chase Copper Water Tube.

Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• The Nation's Headquarters for Brass & Copper

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver†	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston†	Newark	Rochester†	(†Sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	



Everywhere in Every Industry, this Fact is Being Proved...

"All Motors are not alike"

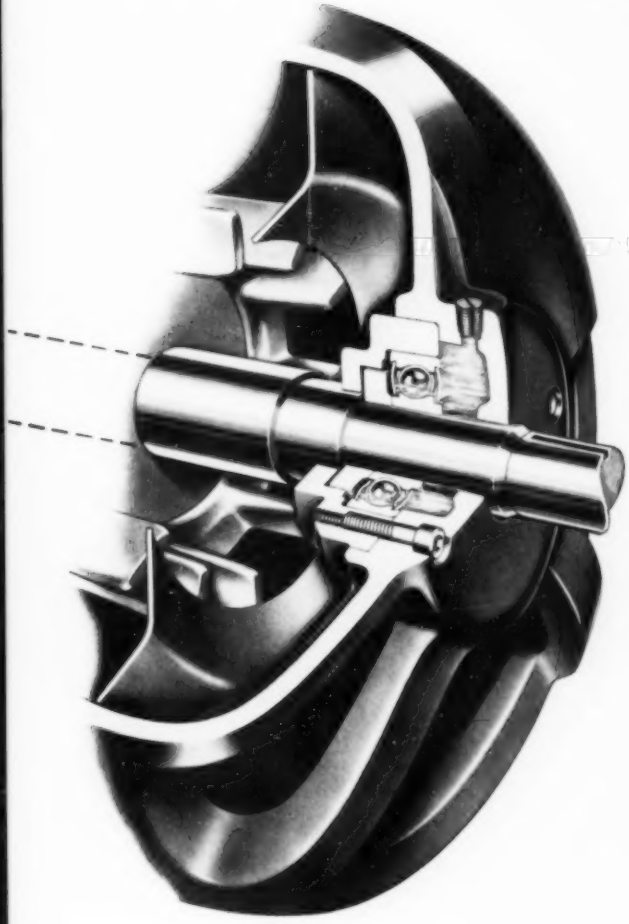
By their superior performance—frequently in rugged 24-hour-a-day service—Reliance Precision-Built A-c. Motors are proving in every industry that *"All Motors are not alike"*. Here are motors which are made differently and made better—to deliver dependable power longer. Their original factory bearing lubrication, for example, provides more operating hours before re-lubrication is necessary than that of any other pre-lubricated bearing. And on the next page you will find a check list of features which combine to make the Reliance design the best pre-lubricated bearing design you can obtain in any motor made today!

RELIANCE
Precision-Built
MOTORS

15 REASONS WHY . . .

the RELIANCE Pre-Lubricated Bearing Design

is the BEST in Electric Motors



- Bearing sealed from dirt and other foreign material.
- Enclosed bearing housing.
- Bearing can be re-lubricated without being disassembled.
- Motor can be re-greased without removing drain plug.
- Automatic grease relief to suit any lubrication system.
- Protection against grease entering windings.
- Balls free of direct pressure during lubrication.
- Bearing can be removed without danger of distortion.
- Reservoir to protect against under-greasing.
- Standard commercial ball bearings.
- Larger grease reserve than provided with any standard bearing.
- Grease supply free of churning action.
- Measuring unnecessary to prevent over-greasing.
- Unnecessary to grease equally at each side of ball race.
- Lubricant is retained in ball race.

Write for Bulletin detailing all of the advantages you get with the RELIANCE Pre-Lubricated Bearing Design

Cutaway views, comparison chart and statements by bearing manufacturers offer more complete evidence of the superiority of the Reliance Pre-Lubricated Bearing Design. Specify Bulletin B-2201.

Reliance PRECISION-BUILT A-c. Induction Motors available from 3/4 to 300 horsepower

Sales Offices in Principal Cities

RELIANCE ELECTRIC AND ENGINEERING CO.

1063 IVANHOE ROAD, CLEVELAND 10, OHIO • CANADIAN DIVISION: Welland, Ontario

EXTRA-TOUGH BRONZE VALVES

FOR LEAK-PROOF SERVICE!

Usual Bronze Valve Diaphragm Construction

Hancock Bronze Valve Diaphragm Construction 125% to 230% Stronger

When you buy bronze valves, get what you want – greatest efficiency, longest service, biggest savings. Extra-tough Hancock Bronze Valves assure *all three* with features like these:

- ✓ "500 Brinell" Stainless Steel Plug Seat and Disc prevent leaks.
- ✓ 125% to 230% Stronger Diaphragm than ordinary bronze valves.
- ✓ Hard-Rolled Bronze Stem (Acme threads) takes the roughest treatment.
- ✓ Long-Lasting, Seal-Tight Packing cuts maintenance.
- ✓ Real Back Seating makes packing easy under pressure. Direct seat between stem and bonnet – away from heat and flow of pressure media.
- ✓ Rigid Body, Bonnet and Bonnet Ring of durable steam bronze withstand installation and service abuse.
- ✓ Cool, Comfortable Handwheel built to operator specifications.

Durable Hancock Bronze Valves are made in sizes from ¼" through 2" – globe and angle types, screwed ends—for 150#, 200# and 300# W.S.P. ratings. Phone your nearby Hancock Distributor for prompt delivery. Remember, Hancocks cost no more than ordinary bronze valves.

When Hancocks go in, valve costs go down.

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** WATERTOWN 72, MASSACHUSETTS

MAKERS OF HANCOCK VALVES, ASHCROFT GAUGES, CONSOLIDATED SAFETY AND RELIEF VALVES, AMERICAN INDUSTRIAL INSTRUMENTS, BUILDERS OF "SHAW-BOX" CRANES, "BUDGIT" AND "LOAD LIFTER" HOISTS AND OTHER LIFTING SPECIALTIES.

NEW! NEW!

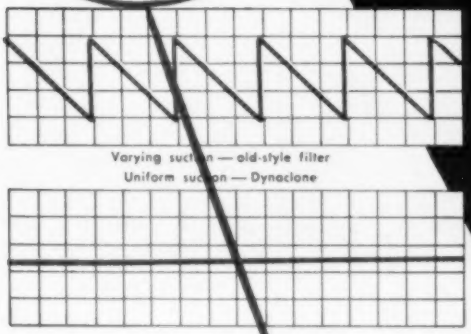
NEW Cloth Screen Dust Filter

SLY DYNACLONE

You saw this ad 2 years ago

offers 5 NEW ADVANTAGES!

1. Eliminates mechanical shaking.
2. Provides uniform suction at dust source.
3. Assures longer bag life . . . 4. minimum maintenance.
5. Keeps itself automatically and continuously clean without additional power or equipment.



Varying suction — old-style filter
Uniform suction — Dynaclone

Send for descriptive bulletin just out on the new Sly Dynaclone — the ultimate in filter performance.

This revolutionary new dust filter is another Sly first. Extremely simple and thoroughly dependable, it eliminates entirely the gremlin of mechanical shaking and provides uniform suction of air at dust source.

This uniform suction is achieved by a simple device which cleans the filter bags successively by a reverse flow of air—the same suction which draws the dust onto the filter cloth is reversed to blow it off.

Since this reverse air suction operates continually, the new Sly Filter requires no shutdowns for removing dust from the cloth.

No mechanical shaking or flexing device is needed, eliminating all strain and wear.

The Dynaclone isn't NEW any more! It has been quietly at work in many industries with results beyond hopes and expectations.

The result of long experimentation and exhaustive tests, the Sly Dynaclone has thoroughly proved itself. It provides substantial savings over any other type of cloth screen dust collection. Write for complete information.

*PATENTED

SLY PIONEERS and LEADERS in INDUSTRIAL DUST CONTROL

THE W. W. SLY MANUFACTURING CO.
4771 Train Avenue • Cleveland 2, Ohio
NEW YORK • CHICAGO • PHILADELPHIA • SYRACUSE
DETROIT • BUFFALO • CINCINNATI • ST. LOUIS
INDIANAPOLIS • BIRMINGHAM • LOS ANGELES • TORONTO

ACEC SERVICE COVERS THE NATION

232 DISTRIBUTORS AND MOTOR SERVICE SHOPS LOCATED FROM COAST TO COAST

NOW ON HAND
Integral Horsepower Electric Motors—conforming strictly to NEMA SPECIFICATIONS
FULLY GUARANTEED

AVAILABLE IN THE FOLLOWING TYPES:

- ★ **Open Drip Proof Motors**
- ★ **Totally Enclosed Fan Cooled Motors**
- ★ **Pump Motors:**
  - Style "C" Face Mounted
  - Style "P" Vertical Solid Shaft
  - Vertical Hollow Shaft
- ★ **Adjustable Speed Schrage Motors**

MOTORS EXCEEDING 200 HP. BUILT TO ORDER

Today, world-famous ACEC electric motors are not only *immediately available* to American customers from warehouses in the United States, but ACEC SERVICE is available from Maine to California, from Washington to Florida.

232 DISTRIBUTORS AND MOTOR SERVICE SHOPS, throughout the nation, are fulfilling the service requirements of ACEC customers promptly and efficiently. *Every* user of ACEC products has the assurance that he can call upon skilled, dependable workmanship to maintain his equipment in perfect running order.

As a designer and manufacturer of electric motors, ACEC has established a world-wide reputation for excellence, and it is the set policy of the management that in matters of performance, promptitude, and courtesy the ACEC SERVICE DIVISION shall continue *unsurpassed*.

Whatever your electric motor requirements, write, wire, or telephone the nearest ACEC office or representative—or communicate directly with us in New York. Inquiries and orders receive immediate attention.

IMMEDIATE DELIVERY from NEW YORK • CHICAGO • KANSAS CITY • NEW ORLEANS • DALLAS and LOS ANGELES Warehouses

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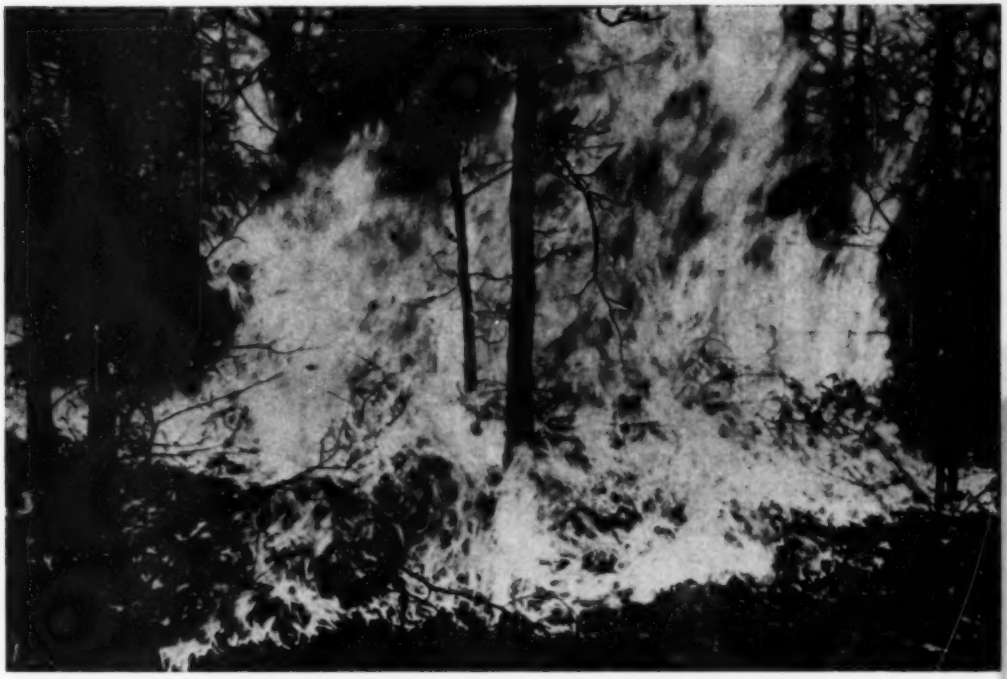
You can't stop a raging fire with a garden hose



You can't stop corrosion with ordinary paints . . .

it takes BITUMASTIC COATINGS!

CORROSION can't be stopped by ordinary paints or conventional protective coatings . . . they can't protect surfaces against the ravages of rust for any appreciable length of time.

But Bitumastic Coatings can!

FIRST—Unlike maintenance paints, Bitumastic® Protective Coatings are specially formulated from a base* of coal-tar pitch that is, for all practical purposes, impervious to water. When you keep moisture away from an exposed surface, you *stop* corrosion.

FURTHER—Bitumastic Coatings provide an extra-tough, extra-thick barrier against corrosive elements—a barrier that is impenetrable. And these coatings provide up to 8 times the film thickness of conventional paint coatings.

FINALLY—Bitumastic Coatings stop corrosion caused by moisture—acid fumes—alkaline fumes—corrosive soil—salt air—heat.

There are 6 Koppers Coatings—formulated to control corrosion of metal and deterioration of concrete. Use the coupon for full information.

**Hi-Heat Gray contains a metallic base.*

SEND FOR SET OF FREE BOOKLETS!

Koppers Company, Inc., Tar Products Division
Dept. 459-T, Pittsburgh 19, Pa.

Please send me, without charge or obligation, your booklets on corrosion prevention.

Name.....

Address.....

City.....Zone....State.....

KOPPERS BITUMASTIC PROTECTIVE COATINGS

SOLD THROUGH INDUSTRIAL DISTRIBUTORS

KOPPERS COMPANY, INC., Tar Products Division, Dept. 459-T, Pittsburgh 19, Pa.

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

FACTS about ANILINE

Today aniline is used extensively in many industries. Aniline is utilized in the manufacture of hydroquinones which are essential to the photographic and rubber industries. Aniline is an important ingredient in the anti-aging compounds used by rubber manufacturers to increase the life of rubber products. As a valuable intermediate, aniline is vital to the production of various dyes and pharmaceuticals, such as indigo, phenylhydrazine, acetanilid, acetoacetanilide. Also it is used in aniline-formaldehyde type resins which exhibit excellent electrical properties.

Despite current shortages of this material, Dow is extremely interested in helping you utilize aniline to best advantage in your manufacturing processes. Dow will gladly cooperate with you if you desire technical assistance or further information about the economical use of aniline. Write to Dow, using the coupon at right.

HANDLING

Aniline is commonly stored in plain steel tanks. These tanks should be vented to a safe place. Although there is no particular fire hazard involved, it is advised that vents should be equipped with flame arrestors. It is also good practice to ground all equipment in which aniline is used.

If possible, it is advisable to use aniline in closed equipment only. When this is not possible, suitable ventilating equipment must be installed. A down-draft exhaust is indicated since aniline vapors are heavier than air.

Properties and Specifications of Aniline

Aniline is a practically colorless, highly refractive, oily, poisonous liquid with a characteristic odor. It tends to darken on exposure to air or sunlight but remarkably little color change occurs if aniline is stored properly.

Freezing Point, °F.	21
Boiling Point, °F.	364
Flash Point, Open Cup, °F.	158
Specific Gravity (77°F./77°F.)	1.021
Solubility (g/100 g.solvent)	
Water (25°C)	3.5
Alcohol	∞
Ether	∞

SPECIFICATIONS

Boiling Range at 760 mm Hg	
IBP-DP, within	1.5°C.
5-95%, within	0.2-0.7°C.
Freezing Point, minimum	—6.3°C.
Nitrobenzene	None
Color	Colorless to straw

This is one of a series of Dow advertisements you may wish to keep on file for reference and information. Write Dow for reprints.

PROTECTIVE EQUIPMENT

Aniline is so readily absorbed that adequate protective equipment should be worn whenever contact is possible. This equipment should consist of a minimum of safety goggles, rubber gloves and apron, rubber shoes or boots and coveralls and underwear.

Whenever an aniline tank is to be entered it should be washed completely free of aniline and fumes. Anyone entering the tank should be provided with a proper harness and life line in addition to the previously mentioned equipment. Another individual should be watching the person in the tank from the outside at all times.

Any individual upon entering aniline equipment should be equipped with approved breathing equipment. This may consist of a positive pressure hose mask with hose inlet in a vapor free atmosphere or a self-contained breathing apparatus with stored oxygen or air. All masks and breathing apparatus should be approved by the U. S. Bureau of Mines and should be equipped with full face masks.

The precautions taken in unloading tank cars or other containers of any poisonous, flammable liquid should apply to the unloading of aniline.

TOXICITY INFORMATION

Aniline is highly toxic but it may be handled safely if proper care is taken. It is readily absorbed by the body upon contact, inhalation or ingestion. The first symptom of absorption of toxic quantities is cyanosis or blue lips. A feeling of "drunkenness" may exist for a short time followed by headache, drowsiness, nausea and vomiting. This may be followed by unconsciousness and death if exposure continues.

Toxic effects of aniline are generally acute; however, repeated exposure to low concentrations may give rise to what is called chronic aniline poisoning. However, upon complete cessation of exposure, individuals generally regain their normal health with no permanent pathology being in evidence.

FIRST AID

In the event of aniline contact, all contaminated clothing should be removed immediately and the person should be washed with large amounts of soap and warm water. All clothing should be thoroughly decontaminated before further use. In case of eye contamination, the eyes should be washed for at least 15 minutes with large amounts of flowing water. A physician should be summoned as soon as possible.

If aniline is ingested, the victim should be given immediately an emetic such as mustard and water or lukewarm soapy water. In any case mentioned previously or poisoning by inhalation, the patient should be removed from any further exposure . . . kept warm and be transported to the nearest medical attention.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

WRITE DOW FOR INFORMATION AND TECHNICAL ASSISTANCE.

The Dow Chemical Company, Dept. OC-31A.
Midland, Michigan

☐ **Please send me additional information about aniline.**

☐ **Please send_____reprints of this advertisement.**

Name_____ Title_____

Company_____

Address_____

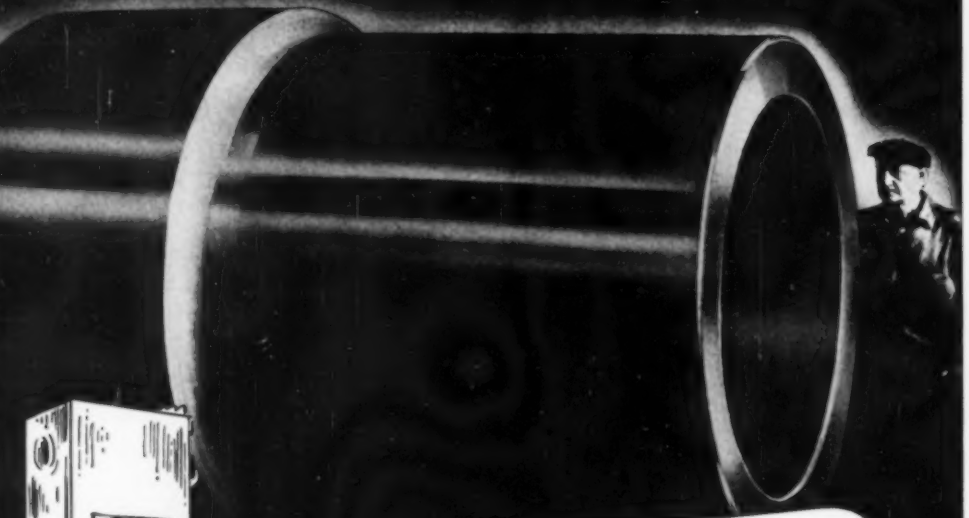
City_____ State_____

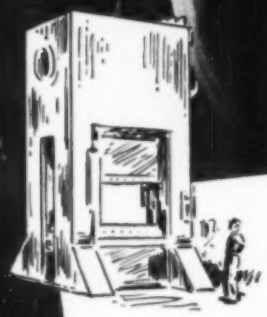
DOW

CHEMICALS

INDISPENSABLE TO INDUSTRY AND AGRICULTURE

PARTS FOR GIANTS...





Press cylinder produced by Midvale for 11,000 ton capacity press for large steel plant in southwest.
DIMENSIONS:
Length outside:
7 ft., 10½ in.
Length inside:
6 ft., 11⅞ in.
Outside Diameter:
66 in. (± 1/32 in.)
Inside Diameter:
51½ in. (± 1/32 in.)

A REGULAR JOB FOR MIDVALE CRAFTSMEN

When the job is big . . . the specifications exacting . . . and the quality to be unsurpassed . . . let Midvale do it.

Press cylinders are one example of Midvale's "extra" in service and quality. For years we have made press cylinders for our own huge presses . . . gained untold experience so we could make our customers' products better . . . built this "first-hand know-how" into the finest, most dependable cylinders industry can produce.

Midvale's modern plants are equipped to make, shape, heat-treat and machine parts for giants in all industries. Pressure vessels for the petroleum and chemical industries . . . rolls for the paper industry . . . roll shells and rings for the mining and cement industries . . . weldless rings for turbines and gears . . . castings and forgings for all industries. If the job is big and must be exact, let Midvale engineers and craftsmen help you.

THE MIDVALE COMPANY
NICETOWN, PHILADELPHIA, PENNA.
OFFICES: NEW YORK • CHICAGO • PITTSBURGH
WASHINGTON • CLEVELAND • SAN FRANCISCO

MIDVALE

Custom Steel Makers to Industry

PRODUCERS OF FORGINGS, ROLLS, RINGS, CORROSION AND HEAT RESISTING CASTINGS

Stockpiles Phosphate well within Pre-purchase Cost Estimates

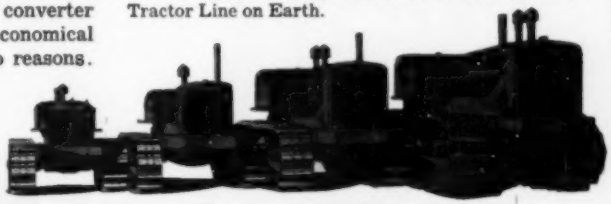
. . . for Florida Phosphate Division of International Minerals and Chemical Corporation.

For handling wet phosphate both to and from storage, Allis-Chalmers torque converter tractors have proved to be the most economical tractors found to date for these two reasons.

MOVE MATERIALS FASTER. Torque converter drive always allows tractor to operate at highest efficient speed under varying load conditions — assures maximum production at all times.

AT LOWER COST. A-C tractors spend more time on the job — far less time in the service shop. Adjustments are easier and lubrication periods greatly extended. Mechanics say these tractors are the easiest to service and repair.

To handle materials the way *you* like it, choose the size that fits the job from The Newest, Finest Tractor Line on Earth.



HD-5
40.6 drawbar hp., 11,250 lb.

HD-9
72 drawbar hp., 18,800 lb.

HD-15
109 drawbar hp., 27,850 lb.

HD-20
Hydraulic Torque Converter Drive
175 net engine hp., 41,000 lb.

For free catalog describing the Allis-Chalmers tractor that fits your job, write: Allis-Chalmers Tractor Division 1127 S. 70th Street, Milwaukee 1, Wis.

Designed for Your Job • Built to Take It • Easy to Service • Easy to Operate

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

Life ...on the

FROM BOOTS TO SADDLES, products marked by distinction, beauty, wearing comfort and durability are made of genuine leather. To help the tanner bring out the qualities in leather, Cyanamid offers a complete line of Tanning Specialties . . . tanning and dyewood extracts, dyewoods, bates, wetting and tanning agents.

NEW 20-page BOOKLET on Aluminum Stearates describes Cyanamid's three new grades for Lubricating Greases. Contains data on physical and chemical properties, discusses gel structure of aluminum stearate lubricating greases and their evaluation. Use the coupon to receive your copy.

FASTER CLEANING OF INDUSTRIAL PRODUCTS ranging from locomotives to small precision parts, is possible with Cyanamid's AEROSOL® Wetting Agents. These quick-wetting compounds decrease the surface tension of water, allowing it to make better contact and spread rapidly along the surface being cleaned.

Chemical Newsfront

AERO* ACRYLONITRILE

AERO Acrylonitrile, now prominently known for its use in the manufacture of acrylic fibers and acrylonitrile-butadiene rubber, continues to attract interest as a base product for expansion into other fields.

PLASTICS Acrylonitrile yields moldable polymers with improved hardness, solvent resistance, and higher softening points.

PAPER Beneficial coatings, improved water and oil resistance, higher tensile strength, greater tear resistance are possible by using products based on acrylonitrile.

ADHESIVES Acrylonitrile is useful in formulating cements that have the flexibility of rubber and cured adhesive strength of phenolic resins.

PLASTICIZERS Acrylonitrile-butadiene elastomers are plasticizers and modifiers for polyvinyl chlorides, phenolic, urea, and melamine-formaldehyde resins.

*Trade-mark

PACKS A PUNCH and is easy to handle . . . that's the way experienced shooters describe AMERICAN Explosives' new twenty-five pound container-cartridge. As the photo shows, this Cyanamid-made industrial explosive is easy to unload and simple to handle. The cartridge has been designed to make blasting as easy as possible and to reduce the loading operation to a minimum of time and labor.

American Cyanamid Company CE. 4-52
30 Rockefeller Plaza, New York 20, N. Y.

Please send me literature or further data on the items checked:

- .. AEROSOL Wetting Agents
- .. Aluminum Stearates
- .. AMERICAN Explosives
- .. AERO Acrylonitrile

Name ..... Position .....

Company .....

Address .....

City ..... State .....

In Canada: North American Cyanamid Limited, Toronto and Montreal

AMERICAN Cyanamid COMPANY

30 ROCKEFELLER PLAZA • NEW YORK 20, N. Y.

PUTTING IT ON THE LINE...

in Industry after Industry!

The Grinnell-Saunders Diaphragm Valve . . . . . .

Here's why . . . Piping in today's complex industrial plants is an exacting science involving the handling of highly corrosive fluids, gases, compressed air, beverages, foods and suspended solids . . . in lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors. Under such conditions, the amazing adaptability of the Grinnell-Saunders Diaphragm Valve explains its acceptance by industry after industry.

Bodies of this versatile valve are made in a variety of metals — iron, stainless steel, bronze, aluminum and others. *But of more importance* is the fact that a body of cast iron (a metal not in short supply) can be lined with glass, lead, natural rubber, neoprene and other materials which, in many instances, handle corrosive fluids *better* than metals.

Diaphragms come in natural rubber, neoprene, butyl, hycar, a special synthetic for foods, and KEL-F. This last is chemically inert to all acids and alkalies in all concentrations with the exception of molten alkali metals.

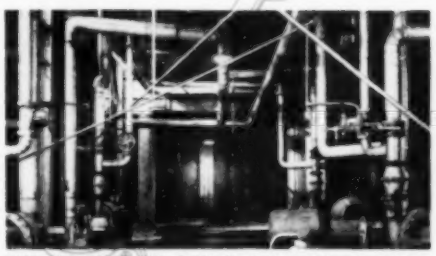
From this broad selection of materials, the problems which the Grinnell-Saunders valve can solve are extremely varied. No wonder industry after industry is putting it on the line.

Showing rising spindle . . . valves are available with rising or stationary spindle.

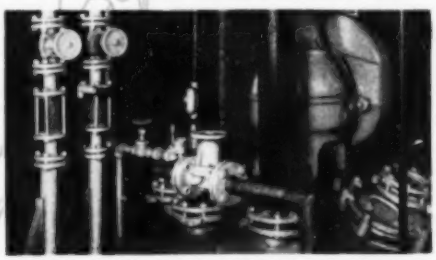
KEL-F diaphragm, using special rubber backing cushion and floating tube nut design.

CHECK THESE GRINNELL-SAUNDERS FEATURES...

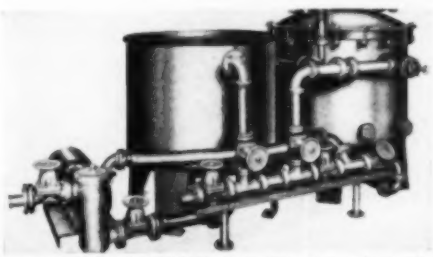
- Diaphragm absolutely isolates working parts from the fluid.
- Diaphragm lifts high for streamline flow in either direction.
- Diaphragm presses tight for positive closure.
- Body, lining and diaphragm materials to suit service.
- Simple maintenance — diaphragm easily replaced.



PULP AND PAPER MILL. Rubber-lined Grinnell-Saunders Valves on stainless steel piping handle sulphate pulp stock in bleach plant of Potlatch Forests, Inc., Lewiston, Idaho.



CHEMICAL PLANTS. Glass-lined Grinnell-Saunders Diaphragm Valves, with KEL-F diaphragms, handle chlorinated organic chemicals at Hooker Electrochemical Company, Niagara Falls, N. Y.



EQUIPMENT MANUFACTURERS. Grinnell-Saunders valves with rubber linings are standard on filtration equipment for solution clarification, made by Industrial Filter & Pump Mfg. Co., Chicago, Ill.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company Inc., Providence, Rhode Island • Sales Offices and Warehouses in Principal Cities

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

It took two railroad cars to provide "passenger accommodations" for this depropanizer tower—as Sun Ship workers readied it for shipment.

tough bronco— PETROLEUM!

Ever see a bronco at the first touch of the saddle? Ever see a gusher well come in? The resemblance doesn't end with the furious first burst of action, even though the saddled pony stands quiet . . . and the stream of black gold pours placidly into the refinery—until man renews his taming process.

Breaking a fractious horse . . . cracking petroleum . . . makes them both useful. And both tasks throw the full test of pressure on the men who tackle the job . . . and on the equipment they use.

Tanks and towers . . . in fact all refinery and chemical equipment built at Sun Ship has been meeting the toughest tests of pressure through years of service. That's to be expected. The men of Sun Ship who build it have shown their ability to meet and master the production pressure of time . . . and the engineering and shipping problems that go with the task of constructing and delivering the gigantic equipment that helps build a greater and stronger America.

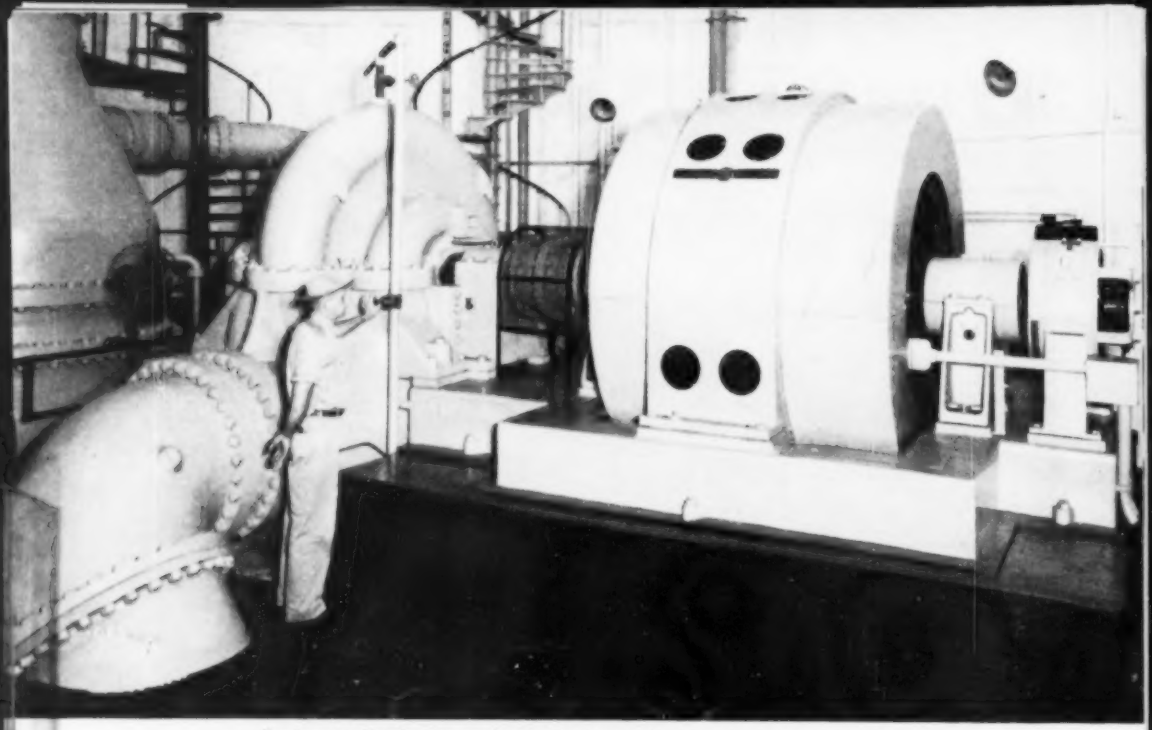
Sun

SHIPBUILDING & DRY DOCK COMPANY

SINCE 1916

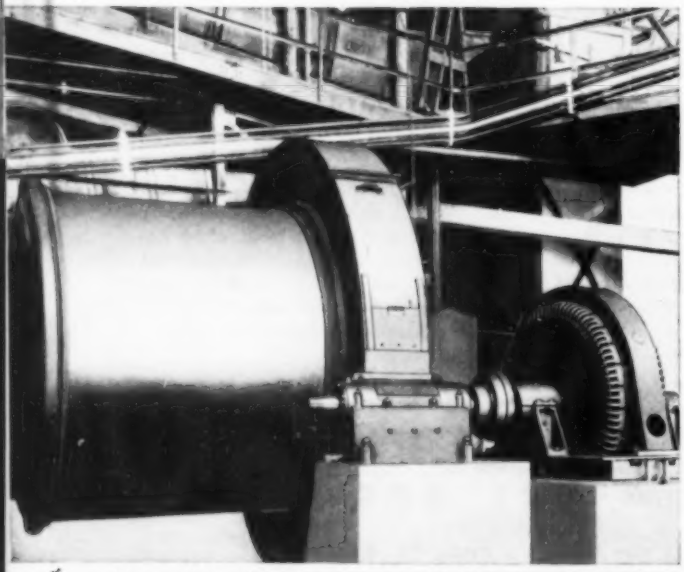
ON THE DELAWARE • CHESTER, PA.

25 BROADWAY • NEW YORK CITY

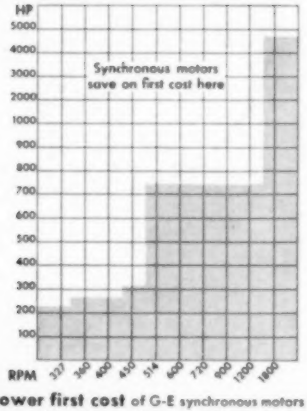


Savings in distribution equipment investment were made possible by selection of this General Electric 2500 hp synchronous motor for a municipal pumping station.

G-E Synchronous Motors

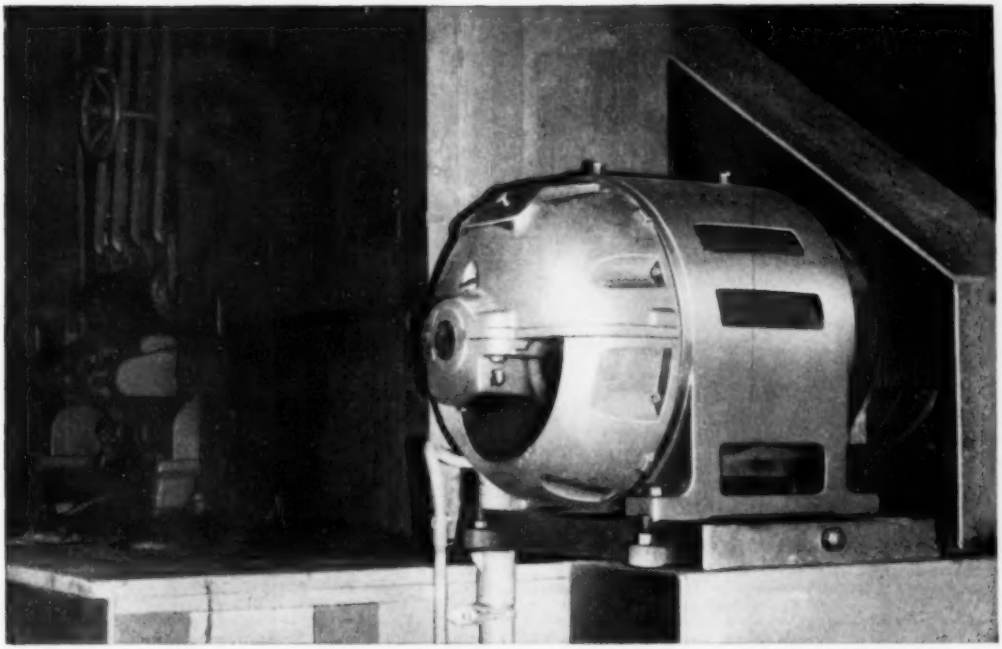


To meet the tough starting requirements of a ball mill, a mining company chose this G-E high-torque synchronous motor rated at 600 hp. Initial cost was low and the motor has given 20 years of dependable service.



Lower first cost of G-E synchronous motors is shown above. For applications in the white area, synchronous motors cost less than any other kind of motor. Calculations below show power savings on a typical 1000 hp, 514 rpm motor.

Gain in efficiency over other types of motors at same rating	**2.2%**
Hourly saving at power rate of $0.01 per/kwh	**$0.184**
Yearly saving (assuming constant operation)	**$1600.00**



Lower operating cost is the rule when General Electric Tri-Clad* synchronous motors are used with equipment such as this horizontal band re-saw, operating almost continuously at heavy loads.

Offer Double Savings

Lower First Costs, Lower Operating Costs Can Be Realized on Large, Constant-Speed Applications in Many Industries

Before you select a drive for a large equipment providing heavy and continuous service, be sure to investigate the economics of General Electric synchronous motors. On many applications such as pumps, compressors, fans, etc., outstanding savings are available.

LOWER FIRST COSTS

In most ratings where horsepower is equal to or greater than speed, the price tag on a synchronous motor with exciter and control is less than that of any other a-c motor with its control.

And, because a synchronous motor improves plant power factor, initial investment in distribution equipment frequently can be reduced. (The load which any new or expanded power system will carry is proportional to the plant's power factor.)

LOWER OPERATING COSTS

A synchronous motor usually has a higher full-load efficiency than any other type of motor, produces more work per dollar's worth of power consumed. Where loads are heavy and continuous, an advantage of from 0.5 to 3.0% in efficiency pays off.

Engineers with many years of field experience will tailor G-E synchronous motors and control to your job. Call in your General Electric representative—he'll be glad to discuss your particular application. And for more information on G-E synchronous motors, write for bulletins GEA-5332 (low-speed) or GEA-5426 (high-speed) to Section 770-26, *General Electric Company, Schenectady 5, N. Y.*

BE SURE TO SPECIFY G-E SYNCHRONOUS MOTORS

The result of more than 55 years experience in development, manufacture, and successful application, General Electric's line of synchronous motors is available in low speed and high speed types, engine-type and Tri-Clad* construction.

Numerous exclusive design and construction features promote long, dependable service. Get the full details!

Reg. trademark U.S. Pat. Off.

GENERAL ELECTRIC

770-36

How would YOU solve these two problems?

VISCOSITY CONTROL is important to Fuller Brush manufacture. Special sealing compound makes their handles stay put. It's applied by expensive equipment. If the equipment is started before the compound is fluid, the automatic machinery will be severely damaged. Now a *low-cost* Fenwal THERMOSWITCH thermostat prevents damage by starting the motor *only* when viscosity is right.

SPOILAGE FROM OVER-HEATING would prove costly to egg producers if water in Paden's Whirl-A-Way egg washer got too hot. Accurate temperature control, under extreme moisture conditions, was called for. *Only* a temperature-sensitive, adjustable, moisture-proofed Fenwal THERMOSWITCH thermostat installation met *all* the requirements at reasonable cost.

A FENWAL THERMOSWITCH CONTROL may solve your problem, too. Its external, single-metal shell expands or contracts *instantly* with temperature changes, making or breaking enclosed electrical contacts. Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved hundreds of problems where heat is a factor.

SEND FOR THIS NEW CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, vapor level, radiant heat, pressure and other variables. Write Fenwal, Incorporated, Temperature Control Engineers, 164 Pleasant Street, Ashland, Mass.

Fenwal

THERMOSWITCH®

Electrical Temperature Control and Detection Devices

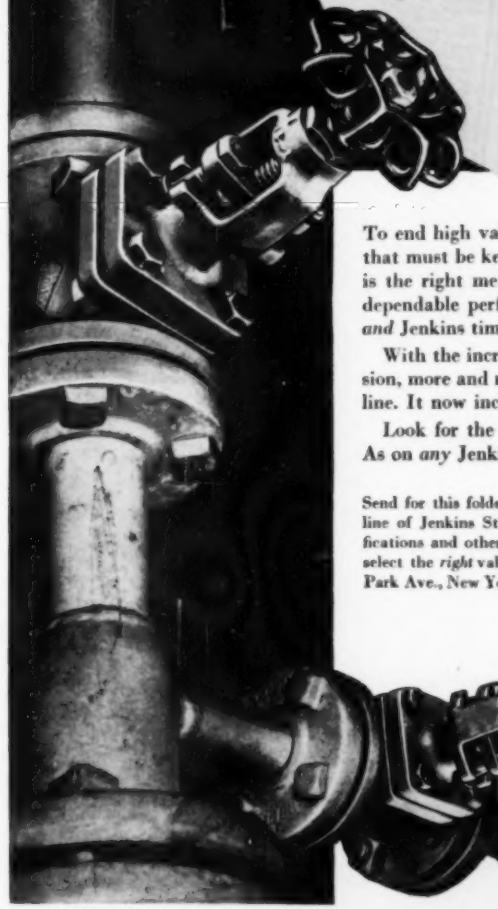
SENSITIVE... *but only to heat*

Here's the hookup
for valve-killing
corrosive services...

Stainless Steel

PLUS

Jenkins Quality



To end high valve mortality from corrosive liquids, and to control fluids that must be kept free from contamination or discoloration, stainless steel is the right metal. But it takes more than metal to make a valve. For dependable performance, you need the two-way hookup—Stainless Steel *and* Jenkins time-proved Valve Engineering.

With the increased demand for processing equipment that resists corrosion, more and more Stainless Steel Valves have been added to the Jenkins line. It now includes types and sizes to meet most industrial needs.

Look for the famous Diamond trade-mark on valves of stainless steel. As on *any* Jenkins Valve, it means extra years of trouble-free service.

Send for this folder, Form 194, describing the complete line of Jenkins Stainless Steel Valves. It contains specifications and other important data that will help you select the *right* valves for your plant. Jenkins Bros., 100 Park Ave., New York 17, Jenkins Bros., Ltd., Montreal.

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES

SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS EVERYWHERE

CORROSION

CHEMICAL RESISTANCE OF "KARBATE" PRODUCTS

This table shows the grade of "Karbate" Impervious Graphite and the type of "National" Resin Base Cement recommended for commercial use in the more common corrosive chemicals. The concentrations and temperatures listed are based on field and laboratory experience, but *the satisfactory use of these materials is not limited to the chemical reagents or conditions shown in this table.*

Chemical Reagent	Concentration	Fluid Temperatures up to	Recommendation	
			Grade	Cement
ACIDS				
Acetic acid	All	Boiling	22	14
Acetic anhydride	100%	Boiling	22	14
Arsenic acid	All	Boiling	22	14
Boric acid	All	Boiling	22	14
Carbonic acid	0-10%	280° F	22	14
Chromium trioxide, aq. soln	All	Boiling	22	14
Citric acid	All	Boiling	22	14
Formic acid	All	Boiling	22	14
Hydrobromic acid	All	Boiling	22	14
Hydrochloric acid	0-48%	185° F	x	14
Hydrofluoric acid	48-60%	——	22	14
Hydrofluoric acid	Over 60%	Boiling	22	14
Hydrofluoric acid	All	Boiling	22	14
Hydrogen sulphide water	All	212° F	22	(†)
Lactic acid	100%	185° F	22	(†)
Monochloracetic acid	0-10%	140° F	x	14
Nitric acid	10-20%	——	22	14
Nitric acid	Over 20%	Boiling	22	14
Nitric acid	100%	Boiling	22	14
Oleic acid	All	Boiling	21	14
Oxalic acid	0-85%	Boiling	22	(†)
Phosphoric acid	100%	Boiling	22	
Stearic acid	0-75%	338° F	x	14
Sulfuric acid	75-96%	——	22	14
Sulfuric acid	Over 96%	Room	22	
Sulfuric acid	All	Boiling		
Sulfurous acid	All			
Tartaric acid				
ALKALIES				
Ammonium hydroxide	All	Boiling	22	15
Monethanolamine	All	Boiling	22	15
Sodium hydroxide	0-67%	Boiling	21	15
Sodium hydroxide	67-80%	275° F	21	15
Tetramine C	All	Boiling		
SALT SOLUTIONS				
Aluminum Chloride	All	Boiling	22	14
Ammonium thiocyanate	0-63%	Boiling	22	x
Arsenic trichloride	100%	230° F	22	14
Calcium chlorate	0-10%	140° F	22	14
Calcium hypochlorite	All	90 °F	22	14
Cupric chloride	All	Boiling	22	14
Ferric chloride	All	Boiling	22	14
Ferrous chloride	All	Boiling	22	14
Ferrous sulphate	All	Boiling	22	14
Manganous sulphate	All	Boiling	22	14
Nickel chloride	All	Boiling	22	14
Nickel sulphate	100%	Boiling	22	14
Phosphorus trichloride	All	Room	21	14
Sodium chloride	0-4%	Boiling	22	14
Sodium chlorite	0-25%	Boiling	22	14
Sodium hypochlorite	All	Boiling	22	14
Stannic chloride	All	Boiling	22	
Zinc ammonium chloride	All	Boiling		
Zinc chloride	All			
Zinc sulfate				
HALOGENS, AIR, WATER				
Air	——	338° F	22	14
Bromine	100%	Room	x	14
Bromine water	All	Room	22	14
Chlorine—dry	100%	Room	22	14
Chlorine water	All	Room	x	
Iodine	100%		x	
Fluorine	100%			

Chemical Reagent	Concentration	Fluid Temperatures up to	Recommendation	
			Grade	Cement
HALOGENS, AIR, WATER cont.				
Steam	——	338° F	22	14
Water	——	Boiling	22	14
ORGANIC COMPOUNDS				
Acetone	0-100%	Boiling	22	14
Amyl alcohol	100%	Boiling	22	14
Aniline	0-60%	338° F	22	14
Aniline hydrochloride	100%	Boiling	22	14
Benzene	100%	212° F	22	14
Benzene hexachloride	100%	Boiling	22	14
Butyl alcohol	0-100%	Boiling	22	14
Butyl "Cellosolve"*	100%	Boiling	22	14
Carbon tetrachloride	0-100%	257° F	21	14
"Cellosolve"*	100%	Boiling	22	14
Chlorethylbenzene	100%	140° F	22	14
Chloroform	——	338° F	22	14
Deoxidine	100%	Boiling	22	14
Dowtherm	0-100%	Boiling	22	14
Diasan	0-100%	122° F	22	14
Ethyl alcohol	0-8%	200° F	22	14
Ethylene chlorohydrin	100%	Boiling	22	14
Ethylene dibromide	100%	Boiling	22	14
Ethylene dichloride	Saturated	Room	22	14
Ethyl mercaptan—water	100%	Boiling	22	14
Freon 11 and 12	100%	338° F	22	14
Gasoline	0-100%	Boiling	22	14
Glycerine	100%	Boiling	22	14
Isopropyl acetate	0-100%	Boiling	22	14
Isopropyl alcohol	100%	Boiling	22	14
Isopropyl ether	100%	Boiling	22	14
Kerosene	All	Boiling	22	14
Mannitol	100%	Boiling	22	14
Methyl isobutyl ketone	0-100%	Boiling	22	15
Methyl alcohol	100%	Boiling	22	14
Monochlor benzene	100%	Boiling	22	14
Octyl alcohol	100%	Boiling	22	14
Paradichlorbenzene	100%	Boiling	22	14
Paraldehyde	100%	Boiling	22	
Tetrachlorethane, sym.	100%			
Trichlorethylene		Room	22	14
MIXTURES				
Ammonium persulfate plus sulfuric acid	25%	140° F	22	14
Calcium chloride plus calcium chlorate	20%	Boiling	22	15
Chlorinated ethyl alcohols	30%		x	
Chrome plating solns.	All	Boiling	22	14
Hydrochloric acid vat with chlorine	Over 20%			
Nickel plating solns. (chloride)	All	Boiling	22	14
Nickel plating solns. (sulfate)	All	Boiling	22	14
Nitric acid plus hydrofluoric acid	15%	140° F	22	(†)
Oakite acid materials—O.C. 32, O.C. 33, O.C. 36, O.C. 84A, O.C. 84M, CRYS. 87, O.C. 88	5%			
Parkerizing solution	All	Boiling	22	14
Rayon Spin bath	All	Boiling	22	14
Sodium hypochlorite plus sodium hydroxide	All	Boiling	21	14
Sulfuric acid plus nitric acid	0.25%		x	——
	96%			
	03%			

(x) Not recommended

NOTE: (†) "National" No. 14 Cement used with threaded joints will give serviceable life.
(*) The term "Cellosolve" is a registered trade-mark of Union Carbide and Carbon Corporation.

The terms "National" and "Karbate" are registered trade-marks of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY • A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
IN CANADA: National Carbon Limited, Montreal, Toronto, Winnipeg

...AND THE CONSERVATION OF CRITICAL MATERIALS

INSTALL NATIONAL carbon and graphite and "Karbate" impervious graphite equipment for processing, conveying and storage of corrosive fluids.

IMMUNE TO THERMAL SHOCK • LIGHT WEIGHT • NO METALLIC CONTAMINATION • LONG LIFE—LOW MAINTENANCE

HEAT EXCHANGERS

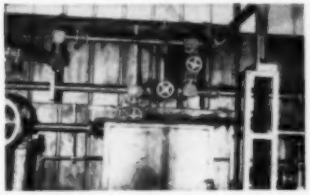
Wide variety of standard and custom built models in time-proven designs. Shell and tube, cascade, concentric and immersion types available in stock sizes. High rates of heat transfer. Catalog Sections S-6620, S-6690, S-6715, S-6716, S-6750, S-6780.

TOWERS

"Karbate" impervious graphite towers for absorption, fractionation, extrusion, scrubbing and many other processing operations. Easily erected from standardized monolythic sections and components. Catalog Section S-7350.

STEAM JETS

Withstand severe corrosive conditions and thermal shock in heating and agitating corrosive solutions by direct injection of steam. Catalog Section S-7300.



PIPE, FITTINGS AND VALVES

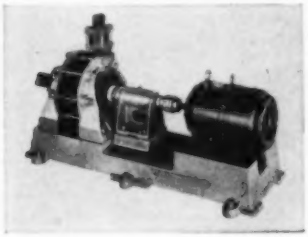
Complete standard line to handle your toughest fluid conveying requirements. Easy to install and maintain with simple hand tools. Catalog Section S-7000.

BRICK

Accepted material for lining tanks, towers, digesters and other vessels containing corrosive chemicals. Catalog Section S-6210.

GROUND ANODES

"National" Graphite Ground Anodes for cathodic protection of buried, submerged or exposed metallic structures provide for control of current input to meet specific environmental conditions. Catalog Section S-6510.



PUMPS

The centrifugal pump for handling corrosive fluids—rugged design, simple construction, trouble-free rotary seal. Handling capacities to 800 G. P. M. Catalog Section S-7200.

HCL COMBUSTION CHAMBERS

Versatile, standardized line for hydrogen chloride synthesis. Burns moist gas. Simplicity of operation. Catalog Section S-7530.

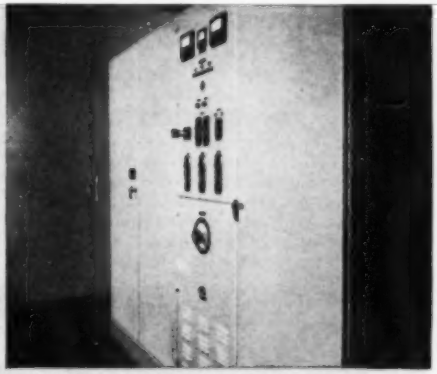
HCL ABSORBERS

Standard and custom built models to meet *any* hydrochloric acid production requirement. Falling-film principal of absorption — proven efficient and compact design. More HCL produced in "Karbate" absorbers than in all other types combined. Catalog Section S-7430.

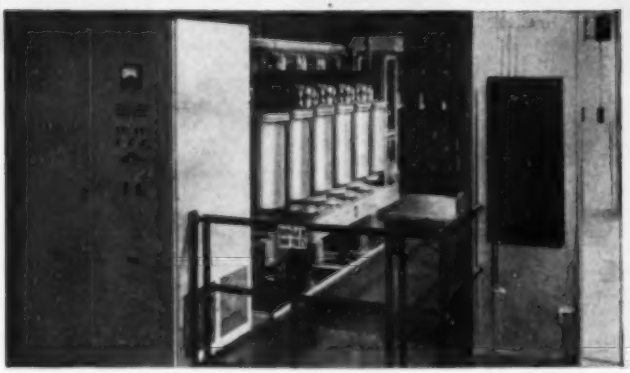
Whether Mine..

ALLIS-CHALMERS MERCURY ARC RECTIFIERS WITH EXCLUSIVE DESIGN FEATURES CAN SUPPLY YOUR DC NEEDS

OUTSIDE view of one of five Allis-Chalmers rectifier substations serving the haulage system of a coal mining operation. Transmission line enters building at right, dc leaves at left. Entire substation can be moved as coal seams are exhausted, leaving only concrete slab behind.



INSIDE is the "dead front," factory packaged, 500 kw, 275 volt dc, sealed tube rectifier. Compartments are (L to R): for rectifier tubes, firing and auxiliary control, dc cathode breaker.



PUMP evacuated rectifiers are applied in heavy duty service from 750 kw up. The 3400 kw, 500 volt unit seen here operates in parallel with steam turbine driven dc generators in the electrolytic reduction of metal.

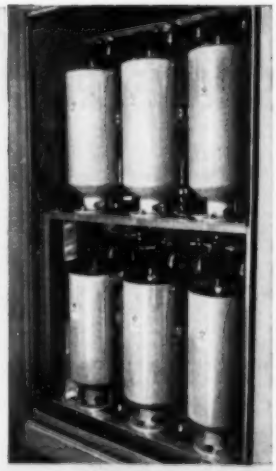
SIDE view of pump evacuated rectifier at left, showing the centralized placement of auxiliaries — exclusively Allis-Chalmers. Both evacuation equipment and heat exchanger are accessibly placed at one end.

ALLIS-CHALMERS

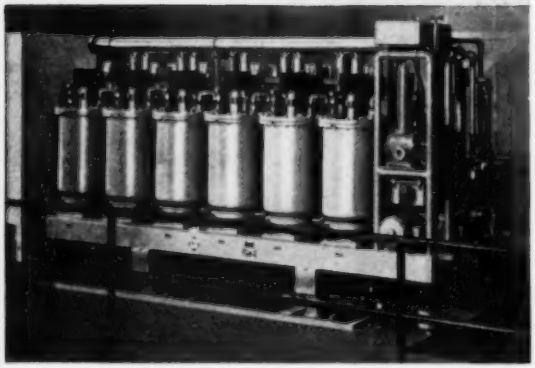
Allis-Chalmers Engineers Introduced Mercury Arc Rectifiers to U.S. Industry

. . or Mill!

ALLIS-CHALMERS MERCURY ARC RECTIFIERS



MODERN Allis-Chalmers design sealed tubes are located in the tube compartment. Other sealed tube units are supplied in ratings from 200 to 1000 kw.



WHEREVER DC IS NEEDED, from the mine to the mill, from the Elevated to the elevator, Allis-Chalmers rectifiers are quietly working away.

They combine the high efficiency, low maintenance characteristics of the mercury arc rectifier with exclusive A-C refinements in design and construction.

Factory packaged, light in weight, and requiring no special foundation, they can be placed right at the load center to cut dc feeder losses. Conversion efficiency is higher at all loads with large power savings during light load periods.

And in addition, only from Allis-Chalmers can you get rectifiers with these exclusive design refinements:

EXCLUSIVE ALLIS-CHALMERS FEATURES

- **Fixed excitation anode** — doesn't contact mercury and is independent of level, turbulence or impurities . . . requiring no adjustment, maintenance or replacement.
- **Continuous excitation** — pilot arc always present, eliminating need for continuous and synchronized re-ignition. Rectifier will ride through severe ac voltage disturbances.
- **Grid phase control** — in cooler and cleaner region near anode, where ion density is lowest.
- **Internal cooling system** — high heat transfer with seamless tube cooling coil located within the rectifier.
- **Arcover-free tank** — eliminates danger of arcing-over to tank by insulating entire arc path.
- **Enamelled anode seals** — multi-layer fused vitreous construction provides high-strength seal, unaffected by thermal variation.

All these design advances are obtainable *only* from Allis-Chalmers. When you consider mercury arc rectifiers in your expansion or modernization planning, consider Allis-Chalmers.

For help with rectifier application and a fuller explanation of exclusive superior features, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3681

10 Mercury Arc Rectifier Advantages:-

★ Compact and light weight ★ No special foundation ★ Push button starting with no synchronizing ★ Quiet operation with high power factor ★ Low idling loss and high conversion efficiency ★ High momentary overload capacity ★ Immunity to frequent short circuits ★ No moving parts, contributing to low maintenance cost ★ No attendance needed during operation ★ Resistant to dust, moisture, fumes ★ Simple construction with long life

A-C ALLIS-CHALMERS

ANNOUNCING

Lapp

TUFCLAD

SOLID CHEMICAL PORCELAIN

ARMORED WITH FIBERGLASS-REINFORCED PLASTIC

Since its introduction 14 years ago, Lapp solid porcelain process equipment has found its way into hundreds of chemical applications where it proved the "first satisfactory answer to the problem" of corrosion or purity. Now, equipment of this same porcelain is available with Lapp TUFCLAD armoring, which adds greatly to its operating security.

THE BODY: Solid Lapp Porcelain, thoroughly vitrified, of *zero* porosity, acid proof through and through. Widely used for severe corrosion service and where metallic contamination cannot be tolerated.

THE ARMOR: Multiple layers of heavy fiberglass woven cloth, impregnated with a special modified phenolic resin of high adhesive strength for bonding to porcelain and between layers of cloth. Fiberglass cloth patterns are heavily coated and fitted around the porcelain, seams overlapped, and oven-cured to full strength and permanently knit to porcelain. Armor shell fully covers porcelain, running end-to-end and *under* flanges.

PERFORMANCE: Armor shell acts as a cushion to protect against impact damage in handling or operation. Insulates porcelain against sudden thermal shock. *Most important,* shell in its own right is homogeneous and tough—will hold line pressures even though porcelain is cracked or broken. Safety to personnel and prevention of loss of product are assured by at least temporary control of lines in case of accident.

EQUIPMENT: TUFCLAD armoring regularly available on all Lapp standard Y and angle valves ½" to 6", plug cocks, safety valves, flush valves, pipe and fittings ½" to 8". Armoring readily adaptable to special shapes—tower sections, nozzles, covers, etc.

THE COST: Premium of about ⅓ over standard unarmored porcelain—still much lower than the cost of alloy or lined equipment.

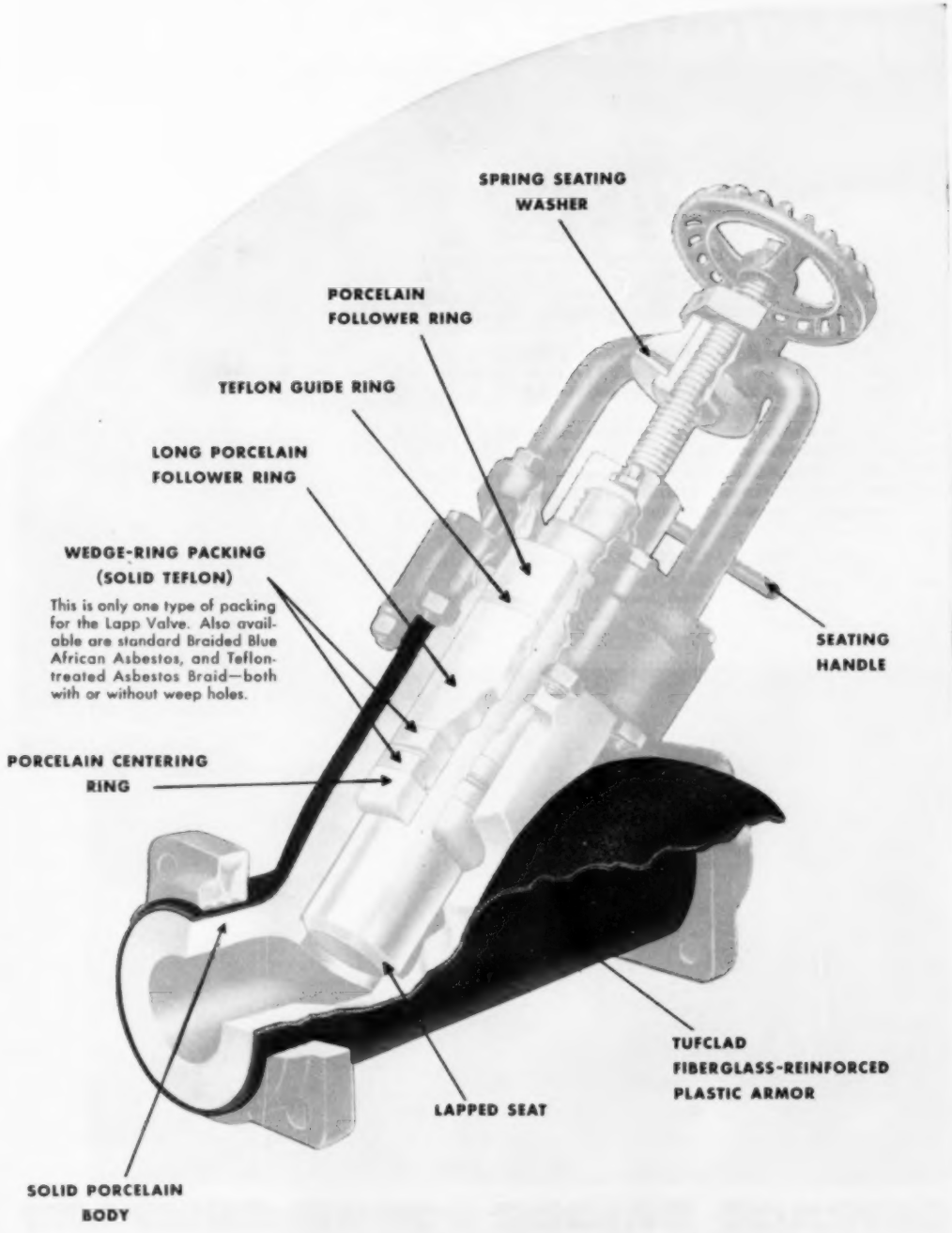
WRITE for Bulletin 315, which covers description and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 500 Maple Street, Le Roy, N. Y.

Lapp

PROCESS EQUIPMENT

CHEMICAL PORCELAIN VALVES • PIPE • RASCHIG RINGS

PULSAFEEDER CHEMICAL PROPORTIONING PUMPS


SPRING SEATING WASHER
PORCELAIN FOLLOWER RING
TEFLON GUIDE RING
LONG PORCELAIN FOLLOWER RING
WEDGE-RING PACKING (SOLID TEFLON)
This is only one type of packing for the Lapp Valve. Also available are standard Braided Blue African Asbestos, and Teflon-treated Asbestos Braid—both with or without weep holes.
SEATING HANDLE
PORCELAIN CENTERING RING
TUFCLAD FIBERGLASS-REINFORCED PLASTIC ARMOR
LAPPED SEAT
SOLID PORCELAIN BODY

HORTON TANK and TOWER
serve new Liquid Carbonic plant

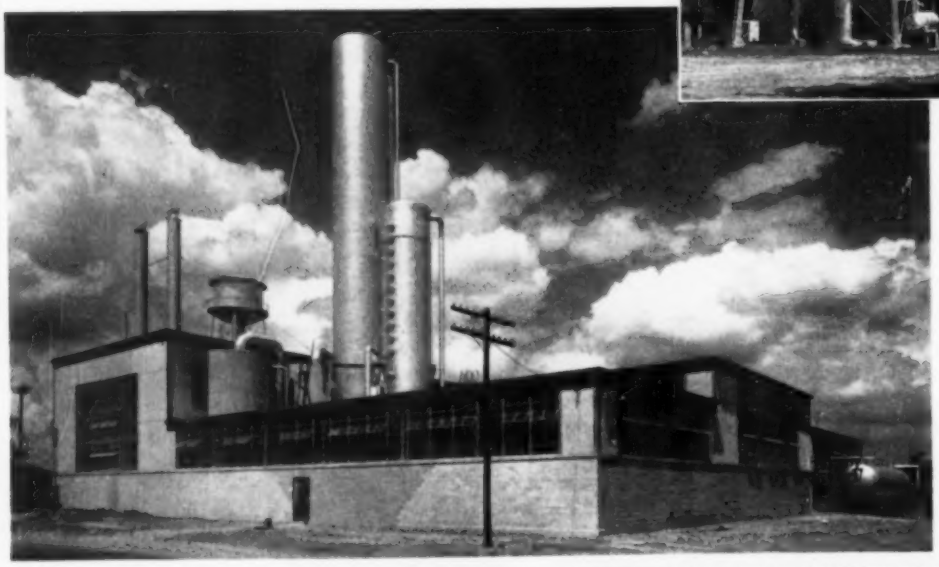
The new Liquid Carbonic Corporation plant in Urbana, Ohio, produces CO_2 either in liquid or solid form for distribution throughout Ohio and parts of Michigan and Indiana. Liquid Carbonic has facilities for making CO_2 at 41 other locations in the United States, Canada, Central America and South America.

This modern plant at Urbana has a capacity of 50 tons of CO_2 per day. The tower, used to absorb CO_2 from flue gas obtained by burning natural gas in a steam boiler, was built by Chicago Bridge & Iron Company.

We also built a 25,000-gal. elevated tank at the Urbana plant to supply water for sanitary purposes, boiler feed and fire protection.

Depend on Chicago Bridge & Iron for both your special plate work and for efficient elevated water storage. For complete information, estimates, or quotations—write our nearest office.

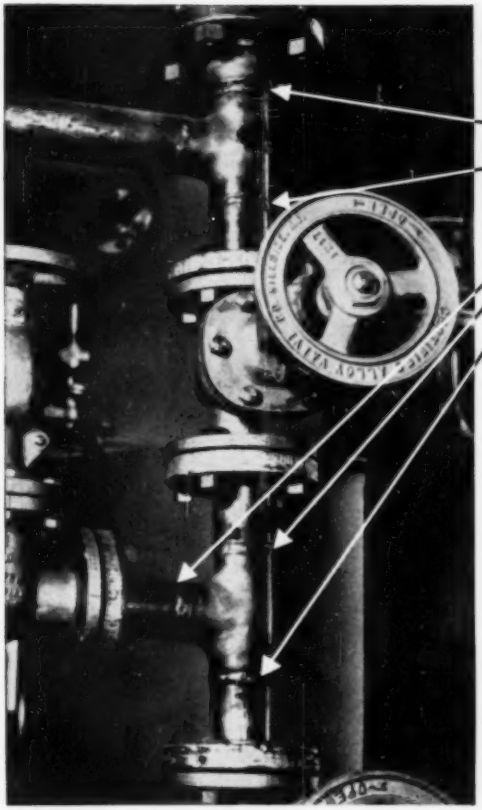
The 25,000-gallon elevated water tank shown at the right and the 12-ft. diam. by 100-ft. absorber tower, shown below, were both built by Chicago Bridge & Iron Company for the Liquid Carbonic Corporation at Urbana, Ohio



CHICAGO BRIDGE & IRON COMPANY

Atlanta 3 ..... 2120 Healey Bldg.	Detroit 26 ..... 1303 Lafayette Bldg.	Philadelphia 3 .. 1625—1700 Walnut St. Bldg.
Birmingham 1 ..... 1510 North Fiftieth St.	Havana ..... 402 Abreu Bldg.	San Francisco 4 ... 1522—200 Bush St.
Boston 10 ..... 1005—201 Devonshire St.	Houston 2 ..... 2103 C & I Life Bldg.	Seattle 1 ..... 1305 Henry Bldg.
Chicago 4 ..... 2124 McCormick Bldg.	Los Angeles 17 . 1505 General Petroleum Bldg.	Tulsa 3 ..... 1623 Hunt Bldg.
Cleveland 15 ..... 2220 Guildhall Bldg.	New York 6 ..... 3318—165 Broadway Bldg.	Washington 6, D. C. ..... 1160 Cafritz Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA



Five Welds Eliminated

if new *Speedline* corrosion-resistant fittings had been used

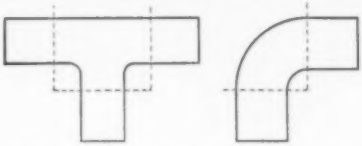
In this typical process plant installation, the use of *Speedline* Tees with Schedule 5 stainless pipe would have saved the time, labor and expense of five welds. *Speedline*'s exclusive "tangential feature" does the trick. This added straight section not only reduces the number of welds required but also eliminates troublesome curved or angle joints.

Many other advantages will be found in the complete line of *Speedline* Fittings . . . all designed to give you fast, low-cost installation of light-wall, corrosion-resistant lines. Exclusive design of flange, for example, eliminates need for flaring or welding. Joints are tight and leakproof . . . a big improvement over other types of fittings.

The cost of *Speedline* Fittings is surprisingly low. And because you can use lightweight Schedule 5 pipe or tubing, your piping costs may be reduced by as much as 40%.

To learn more about this way to improve process piping layouts—at a lower cost than you have been paying, ask for a copy of the *Speedline* Fittings catalog.

Look for the "Tangential Feature"



These drawings show a *Speedline* Tee and 90° Elbow. The dotted lines show the termination points of conventional fittings. Extending *Speedline* Fittings beyond these points provides an extra length of straight section which is sufficiently long to permit attaching of slip-on or insert flanges, or to make any other type joint without fouling. The tangential feature is common to all *Speedline* Fittings such as Ells, Tees, Crosses, Return Bends, etc.

Catalog Shows How to Save Money— Even Under Today's Conditions

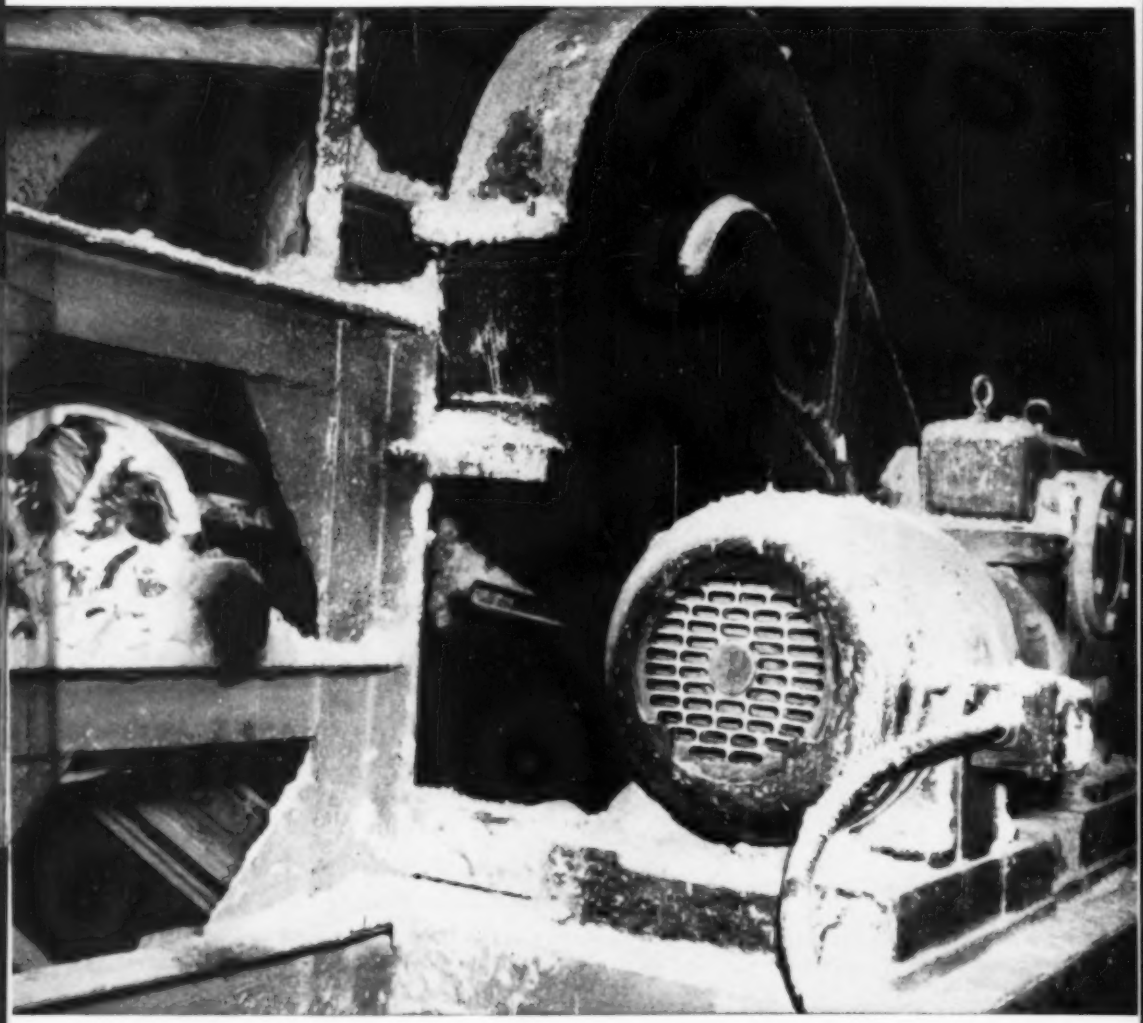
Just write a note on your company letterhead and we will mail the *Speedline* catalog to you. It shows why you get better results at less cost with *Speedline* Fittings.

Speedline **Corrosion-Resistant FITTINGS**

—the newest thing in pipeline economy

HORACE T. POTTS CO. *Since 1815* Erie Avenue & D Street • Philadelphia 34, Pa.

INDUSTRY DOES THE



THE CHEMICAL INDUSTRY depends on standard, "off the shelf," Tri-Clad motors in the most adverse operating conditions, including corrosive, abrasive and explosive atmospheres. The 7½-hp totally-enclosed fan-cooled Tri-Clad motor above drives a crude ash conveyor an average of over 23 hours every day.

GENERAL ELECTRIC

752-12

TOUGH JOBS WITH TRI-CLAD MOTORS

REG. U.S. PAT. OFF.

EXTRA PROTECTION

Every Tri-Clad motor, open or totally-enclosed, is triply-protected against *physical damage, electrical breakdown* and *operating wear and tear.*

That's why you'll find general-purpose Tri-Clad motors in every industry—not only on the usual jobs which they do so economically—but on the *tough* jobs where unfailing performance is a must.

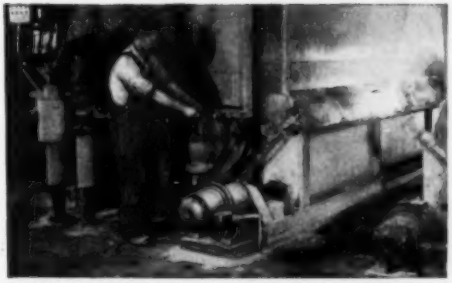
PROMPT DELIVERY

Today especially, delivery and service are important. G-E shipping points all over the country are ready to deliver most standard ratings right out of stock. And with the most complete service shop network in the motor industry you are assured of the best attention to motor problems.

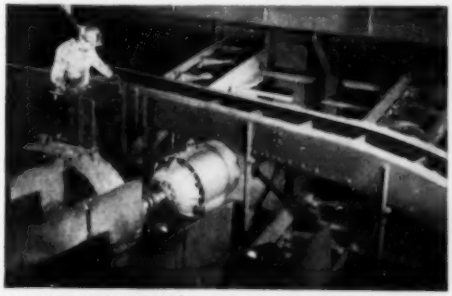
TIMELY INFORMATION AVAILABLE

If you are concerned with training manpower, the new G-E Motor Selection and Application Course, including nine strip films, is a unique and valuable aid. A sample copy of the "Instructor's Manual" (GEZ-310), which outlines the course, may be obtained on request.

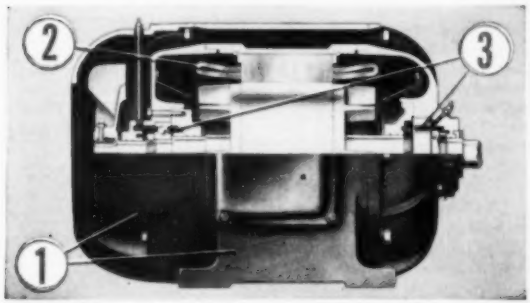
Also available is a free bulletin on "How to Maintain Motors and Generators" (GET-1202). Contact your local G-E sales office for any of the above material, or write *Section 752-12, General Electric Co., Schenectady 5, N. Y.*



FOOD PLANTS on "continuous process" operation depend on Tri-Clad motors to avoid costly shut-downs. Totally-enclosed, non-ventilated Tri-Clad gear-motor above drives a repulper in a sugar refinery.



MINING INDUSTRIES know Tri-Clad motors can take abuse, don't twist out of line and are corrosion-resistant. This totally-enclosed, fan-cooled, Tri-Clad motor runs a coal conveyor.



UNINTERRUPTED SERVICE under tough conditions is assured by many outstanding features of Tri-Clad totally-enclosed motors, for example: 1 rigid, cast-iron end shields and frame; 2 Formex* windings which resist oil, heat, shock, moisture, abrasion; 3 completely enclosed bearings that will last longer because provision is made for relubrication if necessary.

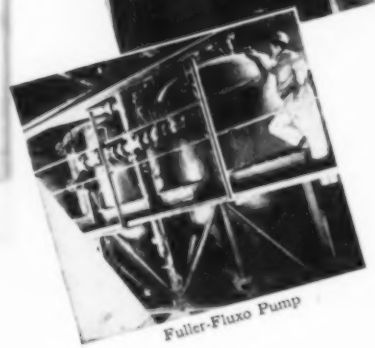
Reg. trademark of General Electric Co.

METAL WORKING FIELD likes Tri-Clad motors because they're easy to mount in any position, rigid and smooth running, and can be relubricated if operating conditions warrant—without disassembly! Six 7½-hp TEFC Tri-Clad motors run machine above which polishes 500 to 1000 metal coffee-makers per hour!

Fuller-Kinyon Pumps

The Airveyor

F-H Airslide



Fuller-Fluxo Pump

You get 25 Years of practical experience in pneumatic conveying

You don't get it from text books—although "book-learning" helps. You get it from the school of hard knocks—experience, plus common-sense engineering . . . continually digging into a problem to find a practical answer. Twenty-five years of this kind of experience has resulted in the ability to design and build pneumatic conveying systems second to none.

This experience, accumulated during the years from hundreds of installations made in various industries, is unequalled anywhere in the field of pneumatic conveying. It is an experience that is difficult, if not impossible, to write into specifications or to show on blue prints; yet it is inherent in every piece of Fuller Equipment.

Fuller occupies a position unique in the field of pneumatic conveying. It designs and builds four primary types, from which it can select the one or combination best adapted to your specific requirements. In other words, there is no guess-work, no "good enough" equipment specified . . . only equipment *best* suited to do the work most efficiently and economically with the materials to be handled.

When you are faced with the problem of conveying dry, pulverized, and granular materials, call in a Fuller engineer for practical, experienced advice.

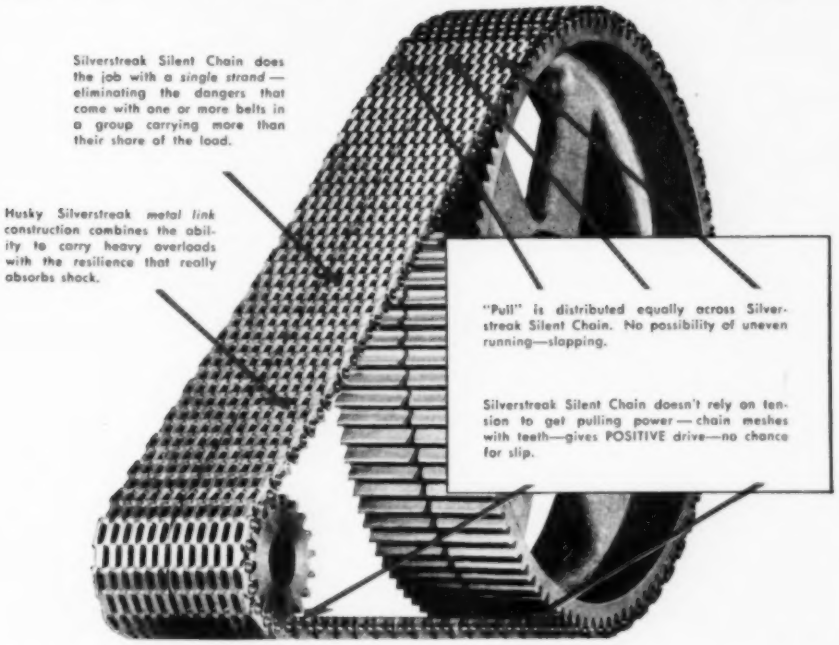
Fuller

FULLER COMPANY, Catasauqua, Pa.
Chicago 3—120 So. LaSalle St.
San Francisco 4—420 Chancery Bldg.

G-70

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS—COMPRESSORS AND VACUUM PUMPS—FEEDERS AND ASSOCIATED EQUIPMENT

How to get Slip-proof Slap-proof Shock-proof power transmission at high speeds


Silverstreak Silent Chain does the job with a *single strand* — eliminating the dangers that come with one or more belts in a group carrying more than their share of the load.
Husky Silverstreak *metal link* construction combines the ability to carry heavy overloads with the resilience that really absorbs shock.
"Pull" is distributed equally across Silverstreak Silent Chain. No possibility of uneven running—slapping.
Silverstreak Silent Chain doesn't rely on tension to get pulling power — chain meshes with teeth—gives POSITIVE drive—no chance for slip.

Drive your machines the proven way — with LINK-BELT Silverstreak Silent Chain

Yes, get the amazing, trouble-free efficiency of 98.2%. A standard of operation that continues throughout the long, long life of the drive. More than this — every rating and design is backed by a record of *proven performance*. And every chain is engineered for the job. You conserve space, too—for Link-Belt Silverstreak Silent Chain Drives operate efficiently on short centers. Ratios as high as 10 to 1 are commonly used.

Little wonder, then, that so many concerns to whom top operation efficiency and rugged dependability are a must, standardize with Link-Belt Silverstreak Silent Chain Drives.

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices, Factory Branch Stores and Distributors in Principal Cities.

12,007

LINK-BELT

SILVERSTREAK SILENT CHAIN DRIVES

HERE'S AN EXAMPLE of how Armstrong data help you select the right size trap for the job:

Armstrong trap capacity figures are based on literally hundreds of tests under actual operating conditions with condensate at steam temperature. The choking effect of flash steam through the orifice as well as the back pressure created by flash steam were automatically taken into account. Actual hookups were used to allow for the effect of pipe friction.

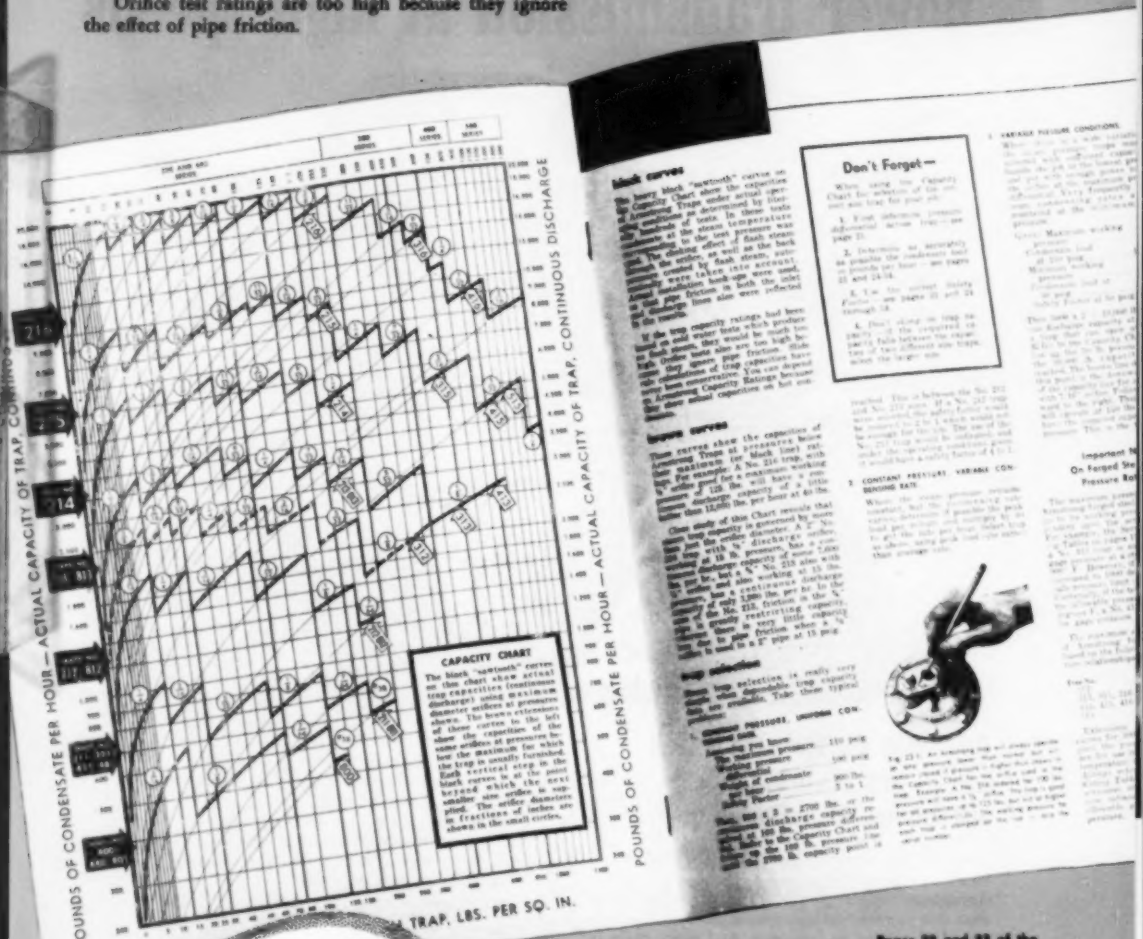
If the capacity ratings had been based on cold water tests, which produce no flash steam they would be too high.

Orifice test ratings are too high because they ignore the effect of pipe friction.

Slide rule calculations of trap capacities have never been conservative.

WHEN YOU SPECIFY A STEAM TRAP you are specifying condensate handling capacity. When you use Armstrong Selection Data and specify Armstrong traps YOU KNOW that you are getting the right trap for the job.

Armstrong traps last longer, too—with less maintenance. And, they are *unconditionally guaranteed* to give complete satisfaction.

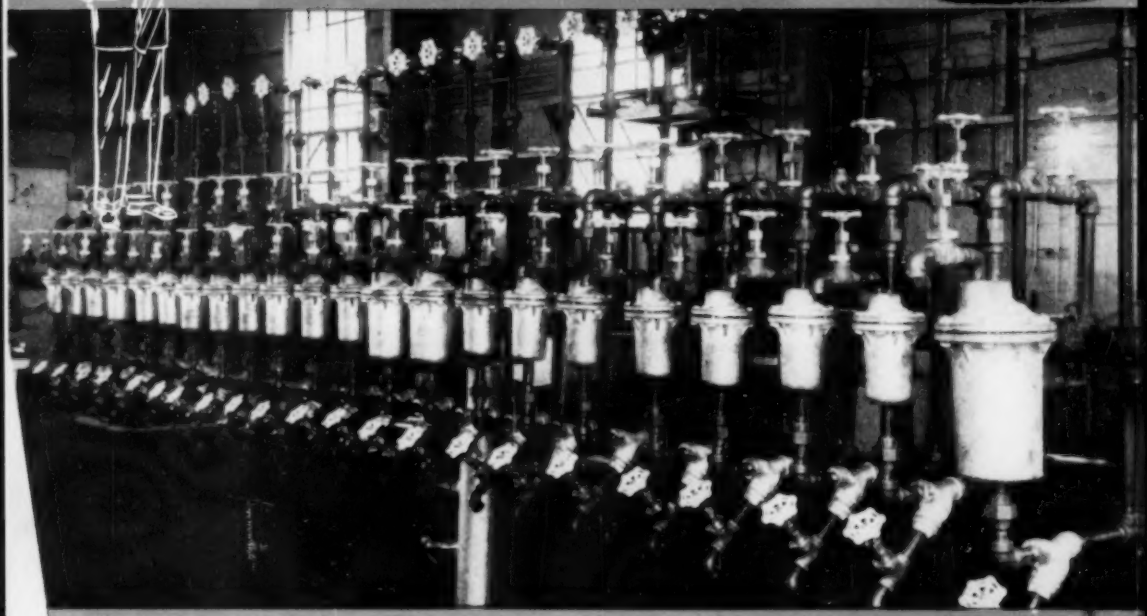

POUNDS OF CONDENSATE PER HOUR—ACTUAL CAPACITY OF TRAP, CONTINUOUS DISCHARGE
CAPACITY CHART
Don't Forget—
Pages 22 and 23 of the Armstrong Steam Trap Book.

You're getting a known quantity when you specify

ARMSTRONG

No trial and error on that job . . . .

ARMSTRONG TRAP DATA are Reliable



THE most carefully calculated installation of steam-heated processing equipment will fail to deliver full output if the steam traps do not have adequate condensate and air handling capacity. When this happens an important part of the capital investment in plant and equipment is wasted.

After you have figured the amount of steam that will be condensed, you need data on:

Condensate Capacity—not theoretical, not estimated, not cold water, but actual test findings with traps discharging condensate at steam temperature (see the discussion on the left-hand page).

Trap Capacity Safety Factors, or ratio between continuous discharge capacity and actual amount of condensate to be handled. These may run from a low of 2 to 1 or as high as 8 to 1. Armstrong data tells you just what safety factor to use to obtain adequate air venting capacity and maximum heat transfer.

Armstrong trap data helps you get traps "big enough" for the job, but not too big; assures you maximum operating efficiency; eliminates corrections after installation. For traps and trapping assistance call your nearby Armstrong Factory Representative.

Left—Side inlet—Side outlet traps for pressures to 250 lbs. for sizes.

Right—Forged steel traps for pressures to 1500 lbs. screwed, socket weld or flanged connections.

Left—Bottom inlet—Top outlet traps for pressures to 250 lbs. Six sizes.

Send for the NEW 44-page Steam Trap Book—including 14 pages of data on how-to size traps for nearly every type of equipment. Free on request—no obligation.

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STEAM TRAPS

LIFE SAVING ANTIBIOTICS BY Pfizer FLOW THROUGH STAINLESS STEEL VALVES & FITTINGS

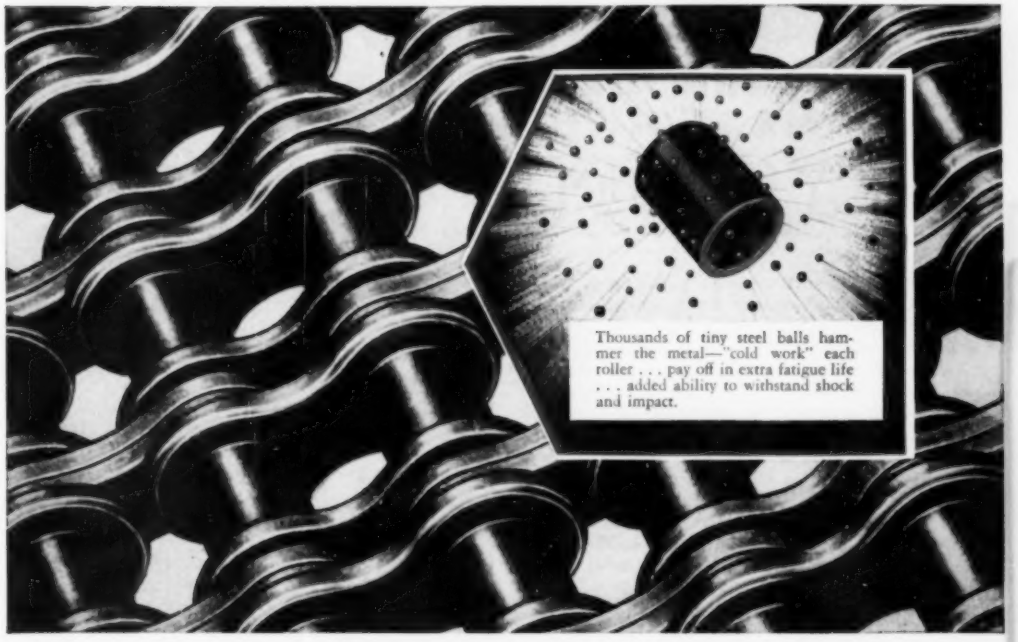
● This man will live—thanks to such "miracle" drugs as terramycin, streptomycin and penicillin. The world over, the balance between life and death hangs on their availability and purity. No one knows this better than the men and women of Chas. Pfizer & Co., Inc.—world's leading producers of antibiotics. That is why Pfizer engineers specify Cooper Alloy stainless steel valves, fittings and accessories for processing units in direct contact with these essential drugs. They know that corrosion resistant metals, cast by Cooper Alloy, mean uninterrupted performance and complete freedom from contamination. Yes, this man will live . . . thanks to medical science, manufacturing integrity, production ingenuity and the reliable performance of stainless alloys.

BY

THE
COOPER ALLOY
FOUNDRY CO. HILLSIDE, NEW JERSEY

Leading Producers of STAINLESS STEEL Valves, Fittings and Castings

Get the roller chain that gives you SHOT-PEENED rollers...


Thousands of tiny steel balls hammer the metal—"cold work" each roller . . . pay off in extra fatigue life . . . added ability to withstand shock and impact.

look for the darkened rollers!

THERE are sound reasons for the universal acceptance of Link-Belt Precision Steel Roller Chain. Two of them—shot-peened rollers and Lock-type Bushings—are shown here.

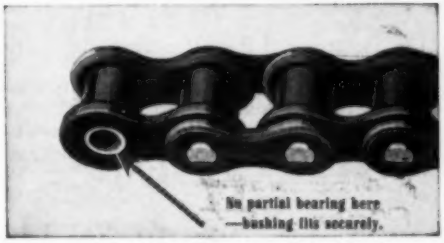
Others include Link-Belt's rigid material selection and controlled heat treating—your assurance of absolute uniformity with no weak members.

Whether it's for drive or conveyor service, you can get the best in roller chain from the complete Link-Belt line—single and multiple widths, in ⅜" through 3", and double pitch, 1" through 3". Next time you need roller chain, call the Link-Belt office near you.

LINK-BELT

PRECISION STEEL ROLLER CHAIN

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices, Factory Branch Stores and Distributors in Principal Cities. 12,007



Lock-type Bushings increase ability to withstand shock loads

A special manufacturing process securely locks the inside sidebars on the bushing, preventing lateral movement of the sidebars and eliminating a common cause of stiff chains. This Link-Belt development is applied on roller chains through 1" pitch and double pitch roller chains through 2" pitch.

Tough GASKETS

FOR TOUGH JOBS ARE MADE WITH TYGON

TYGON GASKET — in service against 85% acetic acid, at 160°-175°F lasts over a year compared to a few weeks' service from rubber. Photo courtesy Hoffman-LaRoche Inc.

One sure answer to tough gasketing problems is the versatile corrosion-resistant TYGON family of plastic compounds. For, TYGON not only resists acids, alkalies, oils, greases, some solvents, and water — but, is strong, resilient, abrasion-resistant and light in weight. TYGON is also impermeable, non-contaminating and non-oxidizing. TYGON can be used for virtually any gasketing job in chemical processing and general industrial equipment — wherever positive, enduring seals or separators are required. For food and beverage uses, special non-toxic compounds are also available.

For service as gasketing, TYGON is made in a number of standard compounds, translucent or glossy black, which offer a range of physical, electrical, and chemical properties for almost any application.

TYGON gaskets can be die-cut from calendered or press-polished sheets ($\frac{1}{64}$" to $\frac{1}{2}$" thick); can be molded in practically any size or shape; or, can be extruded as tubing, solid cord, or channel in continuous lengths.

Write today, for further information and technical assistance on the use of TYGON as gasketing. Ask also about the other uses of this versatile plastic that can help you combat corrosion.

TYGON TUBING

fully flexible, glass-clear, mirror-smooth for safe, speedy transmission of liquids, gases and semi-solids.

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PLASTICS AND SYNTHETICS DIVISION

THE Chementator

Reg. U.S. Pat. Off.

Prepared under the editorial direction of Joseph A. O'Connor, News Editor

Output of coal chemicals climbs

More coal chemicals, from which nylon, pharmaceuticals, dyes and thousands of other products are made, will be produced as a result of the huge expansion of the iron and steel industry.

To operate new and enlarged blast furnaces, the steel mills will need more coke. In the expansion program, a net increase of more than 6 million tons is expected in annual capacity of coke ovens. In 1951 annual capacity was 66,261,000 tons.

That much expansion of byproduct coking capacity will provide huge quantities of chemical raw materials for the manufacture of everything from sulfa drugs and plastics to DDT.

A ton of coal in a modern coke oven will yield in coal chemicals about 8 gal. of tar, 20 lb. of ammonium sulphate, 6,000 cu. ft. of surplus gas and about 3 gal. of light oils. Ammonia is also recovered.

Total output of coke by all processes reached a record high of about 79 million tons in 1951, up about 9.6 percent from the previous year.

Citric acid by deep fermentation

Researchers of the U.S. Department of Agriculture at the Northern Regional Research Laboratory in Peoria, Ill., are now pilot-planting their process for submerged fermentation of molasses to produce citric acid.

With the exception of the comparatively small amount made from citrus fruit wastes, usually between 2 and 3 million pounds a year, most citric acid is now made from beet molasses or a mixture of beet and cane molasses, principally in shallow pans. Citric capacity at present probably exceeds 50 million pounds.

USDA has long sought a deep-tank fermentation process for making citric acid from cheap raw materials. USDA researchers found that by adding methanol or ethanol to a commercial glucose medium they could improve the yield of citric acid in pan culture.

A little methanol added to the medium makes the fermentation organism *Aspergillus niger* tolerate the iron and manganese in unrefined starch and sugar products. The methanol is entirely removed from the citric acid during purification.

In submerged cultures, addition of methanol increases yields of citric acid threefold to eightfold with commercial glucose, sevenfold with cornstarch and twelvefold with blackstrap molasses. In fermentations in stainless steel vats, 60 g. of citric is obtained from every 100 g. of glucose. Yields from blackstrap are about the same.

Methanol at about 35 c. per gal. would cost roughly 1 c. for each pound of sugar. USDA experts in Washington say the cost of the methanol needed seems to be less than that of purifying the sugar solution by ion exchange. Several commercial firms have asked USDA for details of its process.

USDA, of course, is not the only one to come up with a submerged fermentation process. At Groton, Conn., where it recently doubled citric acid capacity, Pfizer, the biggest producer, uses both tray fermentation and submerged fermentation.

Miles Laboratories also uses deep fermentation in its new Elkhart, Ind., plant, which can probably turn out about 5 million pounds of citric acid a year. That capacity could easily be doubled by expansion. When its new Callender, Calif., plant starts producing citric acid, Stauffer Chemical will use a new accelerated molasses fermentation process.

In the new Miles process, air is bubbled through the fermentation medium. To maintain the right concentrations of such trace elements as iron and zinc in molasses feedstock, cation-exchange resins can be used. Adding morpholine and ammonium carbonate apparently increases the yield of citric and cuts conversion time.

New targets for coal-tar chemicals

DPA has set expansion goals for five coal-tar chemicals. By January 1953, it wants output of anthraquinone vat dyes lifted to 48 million pounds, a 30 percent increase in two years. By January 1954, it would like to see resorcinol production up to 10 million pounds, and naphthalene capacity boosted to 555 million pounds, 58 percent higher than in January 1951. By the beginning of 1955, DPA wants maleic anhydride capacity jumped 80 percent over January 1951 to 49 million pounds. Also by 1955, DPA wants quinoline up to 5.8 million pounds—a staggering increase of 416 percent.

If all the companies that submitted applications for certificates of necessity act upon them, the goals for naphthalene, maleic and vat dyes can be met, according to DPA.

Planned quinoline expansion falls 2.5 million pounds short, and current resorcinol projects are 2.16

million pounds shy. Resorcinol has important military uses. And quinoline, normally used in the production of niacin, one of the vitamin B group, is needed to make copper-8-quinolinolate, used to mildewproof military equipment.

How chemicals fare in fast writeoffs

Surveying major industrial expansion programs, DPA finds that of 7,188 certificates granted for fast amortization, 507 went to the chemical industry. Of the $14.5 billion investment proposed, more than $1.6 billion or 11.6 percent of the total is by the chemical industry. Solely from the certificate angle, the chemical industry has the third biggest expansion slated, iron and steel being first and railroads and other transportation second.

The NPA's Chemical Division had, by mid-March, received a total of 1,200 applications. About 900 have been acted on by NPA and forwarded to DPA. Of these 900, about 600 have been acted on (507 approved) and 300 remain to be granted or turned down.

Of the 300 still in NPA's Chemical Division, 50 have been reported on, and will be submitted to DPA as soon as expansion goals are set. The remaining 250 are still being processed.

NPA is still getting applications. During February, for example, NPA received 53 new ones for expansion in chemicals.

The way it looks now, however, there will be no great rush to grant more certificates except for certain special programs—like sulphur, for example—because "things are not too bad."

That was the consensus of chemical executives and NPA officials when the chemical industry advisory committee met with NPA Administrator Henry H. Fowler recently in Washington.

The committee, which represents a cross section of all chemical producers, thrashed out specific programs, and NPA Administrator Fowler gave members a fill-in on the current situation as the government sizes it up. The meeting, presided over by Director Osgood V. Tracy of NPA's Chemical Division, broke up after three and a half hours with everyone feeling that things are under control.

Dixie cottons to chemicals

Chemical industry is growing faster than any other industry in the South. Last year, more than half of the nation's new chemical plants, valued at $600 million, went into the South. In the past three years, chemical plants worth $1 billion have been erected there.

The South's resources of petroleum, natural gas, sulphur and other minerals are luring more and more chemical companies. Du Pont, for example, has built almost all of its new plants in the South since World War II and now has 20 large plants operating in nine southern states.

Fastest growing chemical empire in the world is in the Gulf Coast area. Between Brownsville, Tex., and Lake Charles, La., more than 60 companies now produce nearly 200 organic and inorganic chemicals in 80 new plants. Texas alone has more than 60 big petroleum refineries.

There's no let-up to the growth of the chemical industry in the South. It's estimated that ammonia production will be increased by 1 million tons per year. Ninety percent of the synthetic rubber industry is in the South, and it's a growing industry.

The South outproduces the nation in fertilizers, with Florida and Tennessee setting the pace in phosphates, while Maryland leads in mixed fertilizers.

Long the prime source of cottonseed and peanut oil, the region now crushes soybean and other oilseeds. In production of vital tung oil, Mississippi is first in the nation, with Florida next.

The South also produces most of this country's naval stores—turpentine, rosin and their derivatives. Georgia, the biggest producer, supplies many foreign markets.

More than 60 large pulp and paper mills are now operating in the South. Their daily capacity: nearly 25,000 tons. Nine new mills, to cost $200 million, are under construction.

Dixie has taken the national lead in textile manufacturing, and is steadily increasing its advantage. The region produced $2.1 billion worth of textiles last year, and paid textile workers $1.2 billion in wages. And the South is getting much of the new synthetic textile industry. Virginia is the first-ranking state in synthetic fiber production.

Each year, the South produces minerals valued at $4.5 billion. Southern states lead the nation in output of bauxite, diamonds, phosphate rock, kaolin, fuller's earth, marble, feldspar, mica, zinc and lead ore, ball clay, pyrites, bromine, graphite, helium, magnesium, natural gas, petroleum, antimony and sulphur. New plants will enable Dixie to produce more aluminum than any other area.

Atomic energy is big business in the South. Not only is Oak Ridge, Tenn., busier than ever, but another gaseous diffusion plant is being built near Paducah, Ky., a $500 million giant that Carbide & Carbon will operate. And, most staggering of all, the $1.25 billion Savannah River hydrogen bomb plant is being built by Du Pont in South Carolina.

The South produces 90 percent of the raw materials for the U.S. plastics industry, while it manufactures only 10 percent of the finished plastic goods. However, the South is expected to get a large share of the plastics industry, which may triple by 1960.

(*Continued on page 112*)

To dust they shall return...

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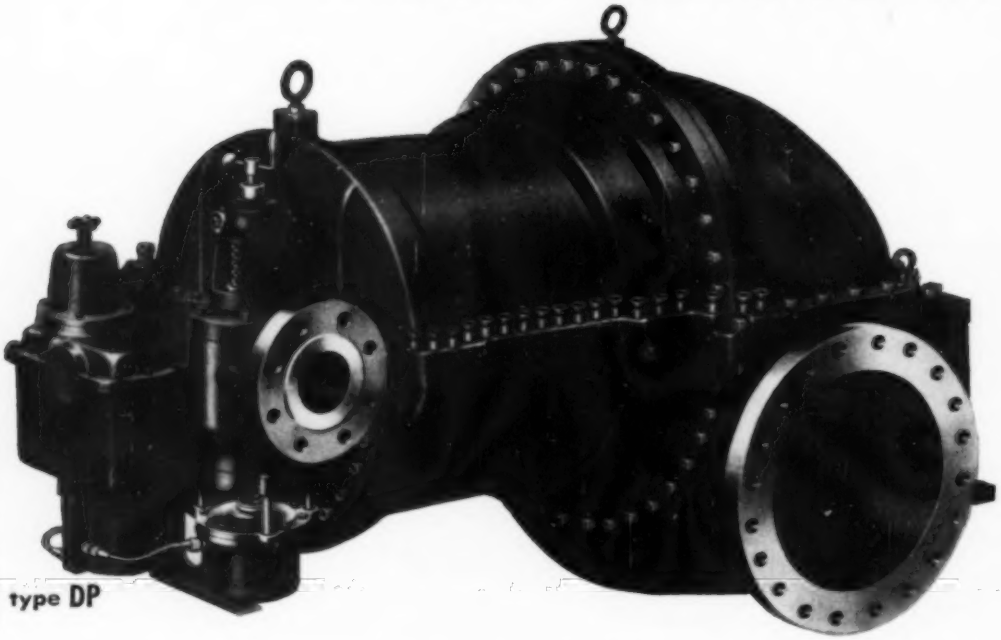

type DP

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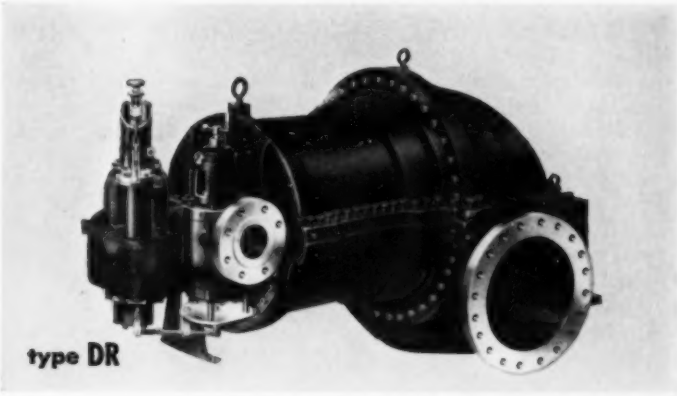
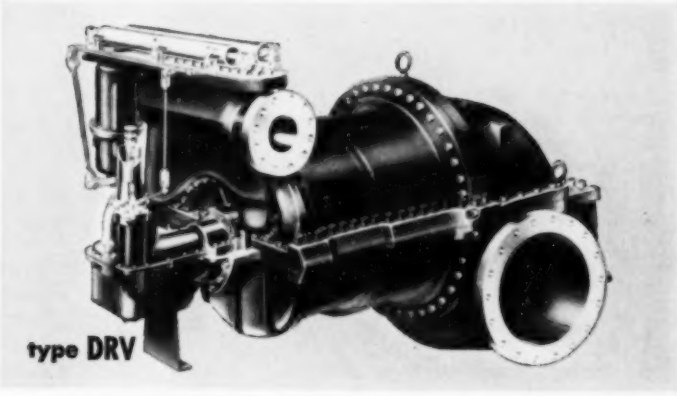


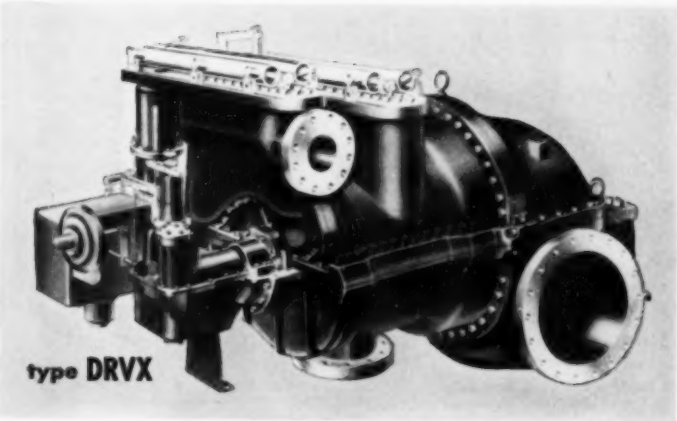
type DR

Oil-relay governor makes possible a speed range of 6 to 1, with only 4 per cent regulation and ½ per cent steady state speed variation.



type DRV

Automatic sectional valves linked to the oil-relay governor minimize throttling losses under fluctuating load factors, make possible substantial operating savings.



type DRVX

For applications where process steam is desired at a definite, steady pressure. Extracted steam pressure remains constant even when load on the unit fluctuates and the flow of extracted steam varies.

Texas tops all 48 states in new defense plants, with Louisiana, Alabama and Kentucky ranking high. The South added an average of one new multi-million dollar plant for each working day during 1951.

Each year the South now imports from other areas industrial supplies and equipment worth more than $2 billion.

Chemical industry is giving the South a big transfusion. The chemical industry invests upward of $30,000 per employee in plant facilities, and pays workers an average of more than $4,000 per year. The new South is not just the land of magnolias and moonlight, but of magnesium and monocyclic terpenes.

New fluorocarbon products

Stemming from work of M. W. Kellogg Co. on plasticizers for Kel-F molding powders, a new line of Kel-F oils, greases and waxes have promising industrial applications. Like Kel-F, a fluorocarbon plastic, these new products have outstanding high-temperature properties, as well as high electrical resistance. Chemically inert, they withstand corrosion.

The Kel-F oils could be used as lubricants where chemical inertness and resistance to high temperature are important. The oils could be used in cable and transformer applications where heat resistance and good dielectric properties are both essential.

Chemical inertness may be valuable in solvents and in providing a sealing medium for instruments. The Kel-F greases have possibilities for stop-cock and plug-cock applications where inertness is a basic requirement. The waxes could be employed as sealing mediums in certain potting, closure or covering uses.

Pharmaceutical plant for Georgia

Merck is completing acquisition of a plant site on the Flint River near Albany, Ga., where the company will produce medicinal chemicals. Production is expected to begin late this year.

Monsanto plants ready to run

Monsanto has a whole rash of new plants slated to start up. Chemstrand, jointly owned by Monsanto and American Viscose, will start turning out Acrilan, its new acrylic fiber, at Decatur, Ala., this month. The nylon plant that Chemstrand is building at Pensacola, Fla., will begin production late in 1953.

Monsanto's new acrylonitrile plant at Texas City, Tex., will be operating by the end of the year; a vinyl chloride monomer plant there will start partial operation toward the end of the third quarter and be in full swing by year's end. A large addition to the styrene plant, also at Texas City, will be running early in the third quarter.

At Avon, Calif., Monsanto's new phenol plant will get going early in 1954. This plant most likely will get its phenol from cumene, probably by a process of Monsanto's own. Also at Avon, a 250-ton-a-day sulphuric acid plant, being built jointly by Monsanto and Tide Water Associated Oil Co., will be operating by the end of the year.

A new government-owned chlorine and caustic soda plant at Muscle Shoals, Ala., being built by Monsanto and Leonard Construction Co. of Chicago, will be the largest in the world under one roof. Monsanto will run the plant for the Army's Chemical Corps. Half of it is completed and starts operating this month.

Money obtained in recent financing has been appropriated by Monsanto's board of directors for expansion projects. This includes $66 million from the sale of income debentures and almost $38 million from the recent sale of common stock.

New record for sulphur production

U.S. sulphur miners set a new production record in 1951. Output of native sulphur, according to the Bureau of Mines, totaled 5,278,249 long tons—2 percent more than in 1950. Production exceeded 400,000 long tons in every month, reaching the highest levels during the third quarter in which the monthly average was 456,523 long tons. In the fourth quarter it dipped to an average of 438,096 long tons.

Over a period of years before 1951, producers' stocks declined continuously as sales exceeded production. By 1951 sulphur stocks were so low that they could no longer be drawn upon. Consequently less sulphur was shipped from the mines than in 1950. Similarly, apparent sales in 1951 of 5,095,347 long tons were 10 percent below 1950. At the end of 1951 producers' stocks totaled 2,837,432 long tons.

Lifting aniline output

By 1954 the U.S. will be turning out 135 million pounds of aniline, not counting capacity of plants in the National Industrial Reserve. That's DPA's new objective in the program to expand aniline capacity.

This is an increase of about 28.6 million pounds over the 106.4 million pounds that privately owned plants were able to produce at the beginning of 1951. Of the 28.6 million pounds of added capacity, 13 million pounds will be provided by unaided private investment. The rest will come from private investment helped out by fast tax writeoffs.

Demand for aniline for rubber processing chemicals has soared because of synthetic rubber production for defense and also because of the stockpiling of natural rubber. It's estimated that 54 percent of the aniline produced goes into rubber chemicals and 22 percent into dyestuffs. Defense has increased output

(Continued on page 114)

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of dyestuffs. Aniline is also used in photographic chemicals, drugs and pharmaceuticals, plastics, resins and petroleum chemicals.

Beefing up polyethylene capacity

Present demand for polyethylene is three times the supply. Producers have new plants under way, but they won't be ready for a year or so. Meantime, despite the fact that NPA expects the situation to ease slightly in the third quarter, when supply should be 50 percent greater than it was in the third quarter of 1951, it is keeping polyethylene under allocation.

Du Pont has started construction at Orange, Tex., to increase output of polyethylene 100 percent. Expansion will cost $10,293,000; a certificate of necessity has been granted. Gulf Refining Co. will string a new 20-mi. pipeline from its Port Arthur refinery to carry ethylene to Orange.

Carbide & Carbon will erect a major unit for polyethylene production at its Texas City plant. A certificate of necessity has been granted for the project, which will cost Carbide $17,694,200. First production will come early in 1953. Estimated output of polyethylene, made by direct polymerization of ethylene at high pressure, is 50 million pounds a year from this unit.

Total U. S. annual production of polyethylene will be between 100 and 150 million pounds by the end of 1952. At that time, defense needs for polyethylene are still likely to be crowding output pretty closely, may even continue to increase during 1953. Big military uses for polyethylene are in field telephone wire, high-frequency cable for radar, harbor defense cables for anti-submarine work and military packaging.

Dixie leads in pulpwood production

The South now produces 60 percent of the total yearly U. S. cut of plywood, and also leads in mill capacity for converting the raw wood into pulp. All-time high for one year is the South's cut of 12½ million cords out of a total U. S. cut of 21 million cords.

Leading southern producer is Georgia, which has harvested 2.2 million cords in a year, or 18 percent of the South's and 11 percent of the nation's cut. Mississippi, which has cut as high as 1.7 million cords, ranks second. Florida and Alabama are next, with about 1.3 million cords apiece. Other million cord states are North and South Carolina and Virginia.

Nine-tenths of the pulpwood being cut in the South is pine. But production of hardwood is increasing from year to year.

Sixty-one pulp mills are now in operation in the South, according to the U. S. Forest Service. These mills can produce 22,800 tons of pulp per day. This is about half of the nation's total wood pulping capacity.

Louisiana's eight mills lead the South with a total daily capacity of 4,000 tons. Georgia mills have a top output of 3,300 tons. Florida mills can produce 3,100 tons daily.

New mills are under construction at Eastport, Fla., and Acme, N. C., and five additional mills are planned. These new mills, together with expansions to existing mills, are expected to raise daily southern mill capacity to 29,000 tons.

Mounting fertilizer demand

U.S. Department of Agriculture estimates that by 1955 the United States will need 70 percent more fertilizer than it consumed in 1950, if agricultural capacity is to be realized.

This 70 percent increase would include 93 percent more nitrogen, 54 percent more phosphoric acid and 77 percent more potash.

Biggest increase in nitrogen requirements is expected in the North Plains states, which will need 322.4 percent more. These same states are likewise slated for the largest rise in phosphoric acid, a 130.7 percent boost. The Lake states are in for the biggest rise in potash, an increase of 95.3 percent. The North Plains states will require the greatest over-all increase in fertilizers—204.9 percent.

Synthetic size pares cost for paper makers

Synthetic sizing agents can, according to Monsanto, save the paper industry $5 million to $7 million annually. Synthetic size has cut operating costs to many mills by as much as one-third and represents savings of $1 to $2 per ton, reports Monsanto's H. J. Hefferman.

In the decade since Monsanto first introduced its own synthetic sizing agent its use has grown steadily. Ninety-five percent of the mills that tried it have adopted it for standard operations.

Paper mills using a blend of three parts of rosin size with one part of the synthetic size have cut their total size requirements by as much as 50 percent. And they still maintain the same sizing level in finished paper. Monsanto has entered into an agreement with Filtered Rosin Products Co. of Baxley, Ga., so that paper mills can get the blended size containing rosin and synthetic.

More soda ash from Wyoming

It's expected that 300,000 tons a year of soda ash will be coming from the $16.3 million plant of Westvaco near Green River, Wyo., by 1953. Now being constructed, the plant will take an annual bite of 650,000 tons out of the trona deposits for its refining operations. Reserves are estimated at 250 million tons of high-purity sesqui-carbonate.

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You can rely on Dow to supply your Diethyl Malonate requirements.

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PROPERTIES	
A colorless liquid.	
Boiling range at 760 mm. Hg, 5-95%	196-200°C.
Specific gravity at 25/25°C.	1.055
Freezing point	Below −20°C.
Refractive index at 25°	1.412
Flash point	200°F.
Fire Point	205°F.

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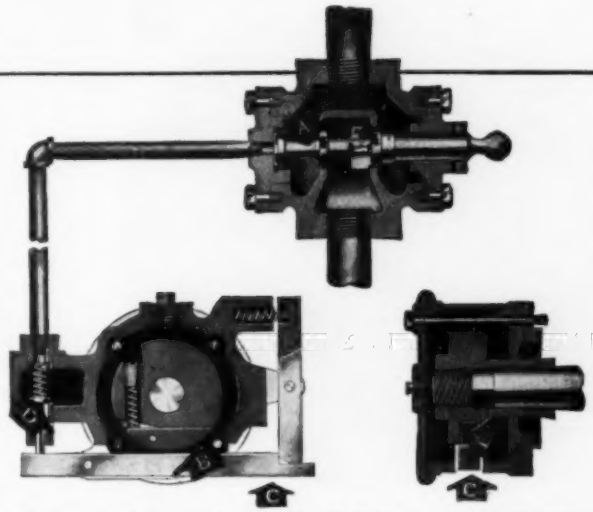
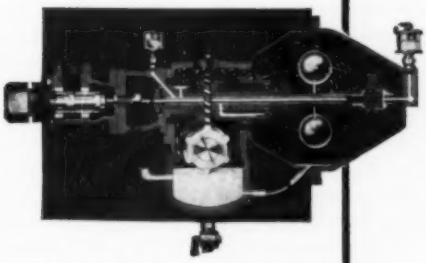
INDISPENSABLE TO INDUSTRY AND AGRICULTURE

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Speed Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When steam is turned on, pressure opens valve A fully. When excess speed is reached, centrifugal force throws weight B against lever C lifting pilot valve D. This releases pressure in back of valve A, closing this valve instantaneously, to shut off the steam. Safety trip can be tested easily while turbine is running by manually tripping and resetting lever C.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

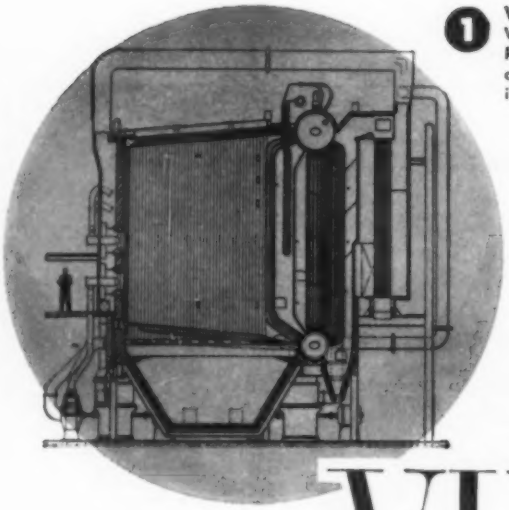
CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION, 224 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

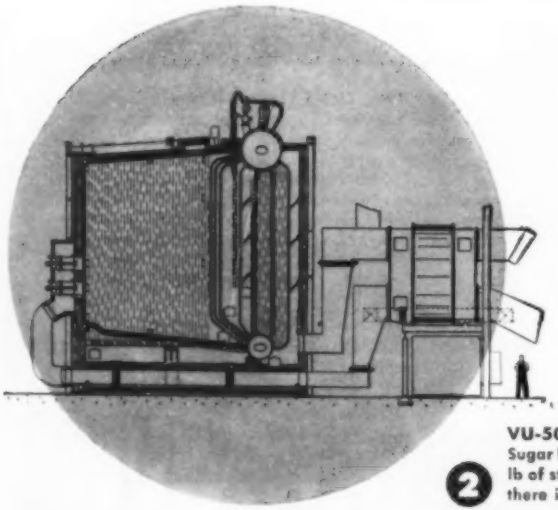
COPPUS "BLUE RIBBON" TURBINES



1 **VU-50 UNIT** used by a Textile Company. This VU Boiler is fired with pulverized coal using C-E Raymond Bowl Mills, or oil as desired. Capacity of the unit is 100,000 lb of steam per hr; operating pressure — 200 psi; steam pressure 500 F.

It seems that the story *never ends* with the purchase of the first Vertical-Unit Boiler. Company after company in the process industries has installed a VU Unit . . . liked it . . . and then bought another — and another — and often another. This is true in every branch of the process industries but four typical cases represented by the text and drawings on these pages will serve to illustrate the point.

one VU is only



A Textile Manufacturer (1) installed a Vertical-Unit Boiler in one of its plants in 1946. In 1949 one more VU Unit was ordered for another of its plants and in 1951 still another was ordered for the same plant.

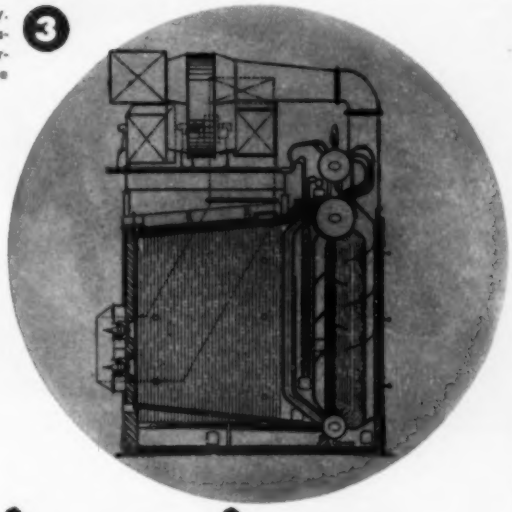
A Sugar Refiner (2) ordered two Vertical-Unit Boilers for one of its plants before the war. In 1946, it ordered a VU for a second plant. And in 1950 another VU was installed in this same plant.

2 **VU-50 UNIT** fired with oil or gas, used by a Sugar Refiner. The capacity of this unit is 175,000 lb of steam per hr; operating pressure is 400 psi; there is no superheat at present.

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

VU-50 UNIT installed in a Petroleum Refinery. Burning natural gas and oil, the unit has a capacity of 260,000 lb of steam per hr at an operating pressure of 400 psi and steam temperature of 660 F.

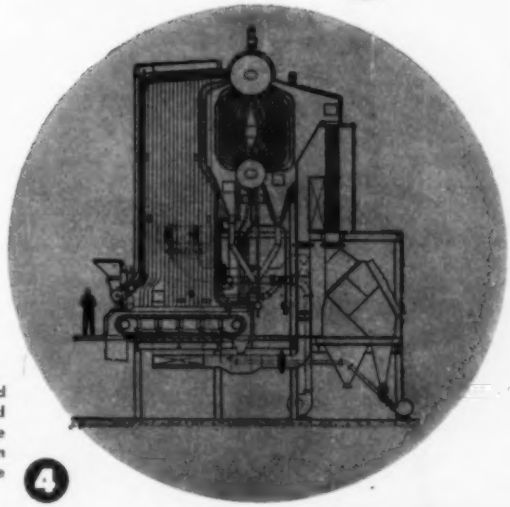


A Petroleum Refinery (3) ordered its first Vertical-Unit Boiler in 1937. A second VU Unit was installed in 1941, and a third in 1950. For another of its plants, two VU Units were ordered in 1942; a third, in 1947.

A Chemical Company (4) ordered two VU Boilers in 1939. In 1946, five more were ordered for three of their other plants. In 1949, two more were ordered for one of these same plants, and in 1950 two more units for a fifth plant. In 1951, seven more VU Units were ordered for still another plant — eighteen units for six plants in twelve years!

the beginning

And so it goes — in all sections of the country — companies in every branch of the process industries . . . paper, food, mining and metal working, brewing, rayon, soap — and many others in addition to the examples pictured here . . . ordering and reordering VU Boilers. There must be a reason — and there is. It's lower steam costs and top reliability. These companies have found *through experience* what they can expect in economy and performance when they buy VU Boilers.



VU-40 UNIT, one of seven, soon to be installed in a Chemical Plant. These boilers will be fired with C-E Spreader Stokers (continuous discharge type). The capacity of each is 60,000 lb of steam per hr at an operating pressure of 325 psi. There is no superheat.

B-570

— SUPERHEATER, INC.

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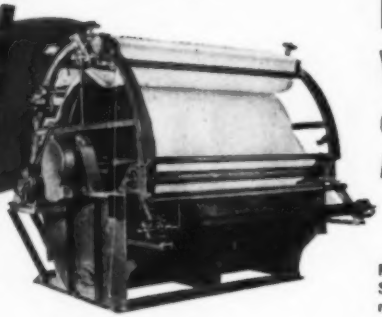
C-E

2 ways TO CUT FILTRATION COSTS...

1



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(with the Original String Discharge)

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Bulletin 103 gives the facts behind this performance. Write for it today.

2

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29

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AND FILTRATION FABRICS DIVISION

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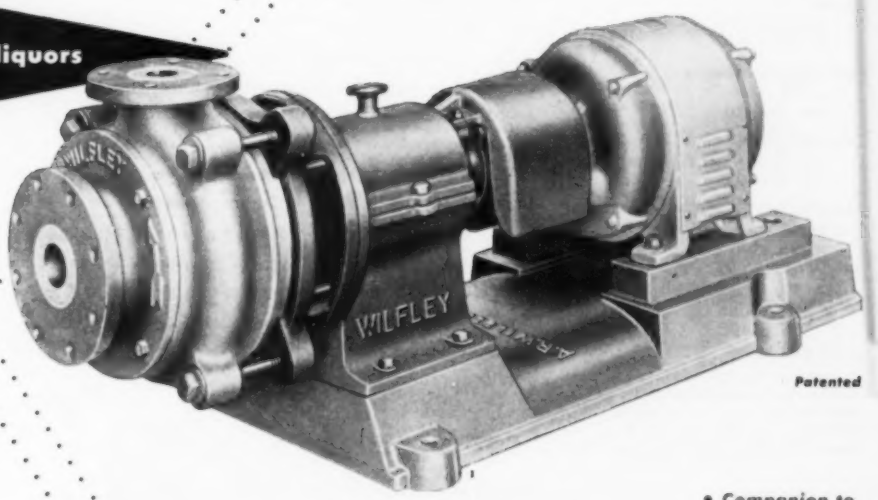

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See CATALOG S-52
Clarage Multitherm conditioning units and fans are covered in Sweet's 1952 Architectural File and in the January 1952 Directory issue of Heating, Piping and Air Conditioning—or write us.

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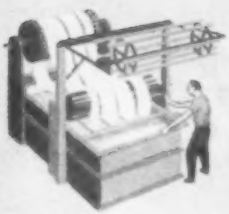

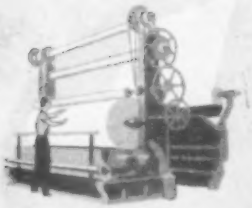

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What business are you in—glass? . . . paper? . . . textiles? No matter what industry you are engaged in, it's important for you to know about this *different* type of technical service.

The staff members of SOLVAY TECHNICAL SERVICE are field experts who have spent their entire careers specializing in individual industries; they are thoroughly versed in alkali chemistry and its uses in these industries. When you call on SOLVAY TECHNICAL SERVICE for assistance, you can be sure that you will get the services of a man who knows *your* industry . . . its methods . . . its problems.

There's no charge or obligation for the services of these "individual industry" specialists. For further information, write in confidence to the nearest SOLVAY office.

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• More Uniform • Lower *Service* Cost

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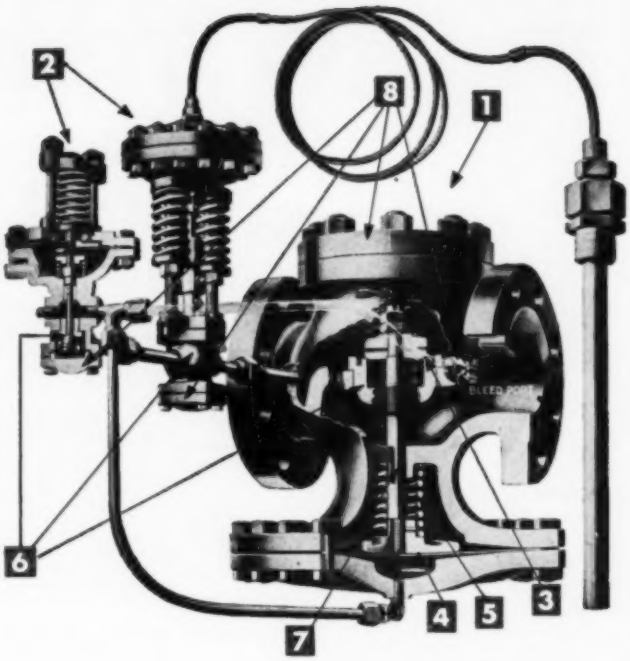
NOW! CUT COSTS OF PRESSURE

These SPENCE features *show you how:*

YOU SAVE MONEY with Spence Self-Operated Regulators because they function dependably and accurately year after year *without requiring extensive repairs or special attention.* This long trouble-free life means less down-time of the system, less time and money wasted on replacement of parts. Thus, you lower over-all costs and, at the same time, are assured of quality performance.



The cutaway illustration above shows why Spence Regulators . . .

REGULATE ACCURATELY

1 The single-seated *packless* main valve is actuated by a large balanced diaphragm. The construction eliminates the need for closely fitted parts which may stick or bind due to uneven expansion or foreign matter.

2 One or more sensitive pressure or temperature pilots control the main valve.

Because the Spence design minimizes friction, accurate regulation remains unaffected by changes in service conditions or length of service.

STAY ON THE JOB FOR YEARS

3 SECO Metal Seats and Discs resist wiredrawing. More than 20 years of experience with SECO Metal in thousands of installations has failed to produce one single case where SECO Metal has been cut by steam.

4 Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

5 The spring in the Spence Regulator is out of the path of the fluid flowing through the valve. It operates at low unit stress to assure performance over an unusually long life.

REDUCE MAINTENANCE

6 The seat and disc of the main valve and pilot can be cleaned and any working part removed, without taking the main valve out of the line.

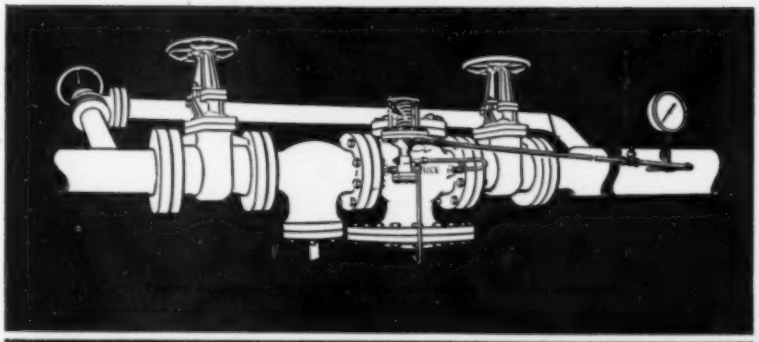
7 All main valves and most pilots are built without stuffing boxes. This packless construction eliminates much time-consuming maintenance.

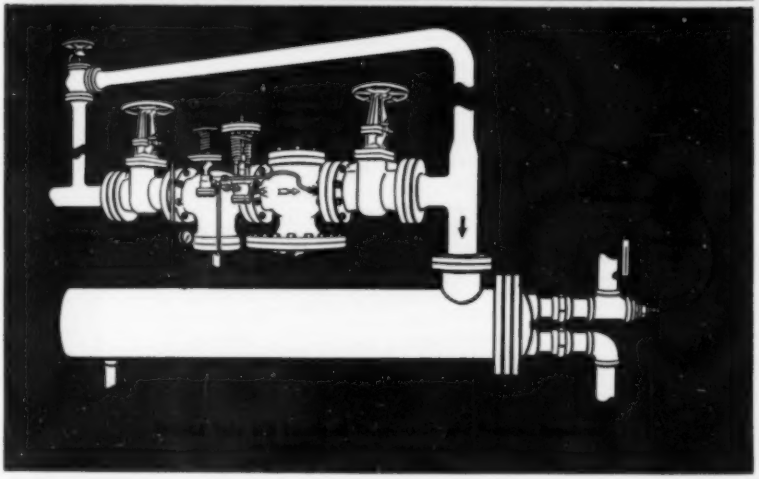
8 No dismantling is necessary to inspect the main valve disc, the pilot valve member and the SECO Metal bleedport. Special openings are provided. Inspection is easier, too, because the pilot is not an integral part of the main valve.

SPENCE ENGINEERING COMPANY, INC.

AND TEMPERATURE CONTROL

TYPICAL INSTALLATIONS





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HAVE UNUSUAL VERSATILITY

9 The Spence Regulator, due to its unique design, will serve many functions and will handle all the various types of fluids under a wide range of service conditions. One of the great advantages of this Spence design is the interchangeability of all pilots on all sizes of main valves. Any main valve can be changed from a pressure to a temperature regulator or vice versa *simply by substituting one type of pilot for another.*

Spence Regulators are built in sizes from ¼" to 12" for service with air, steam, water, oil or gas. With minor adjustments, any Spence Regulator can be easily switched from one service to another.

FREE BULLETIN gives complete engineering details and selection data. It features a full color, fully illustrated description of the operating cycle of a Spence Regulator. Send for your copy of this valuable bulletin today.

9

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Type	Delivery Pressure Range, PSI	Normal Accuracy + or −
D	3-150	1 PSI
D5	1-25	½ PSI
W	0-10	¼ PSI
W7	0-3	½ OZ

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alpha-Picoline beta, gamma-Picoline
Pyridine Sodium Cyanide
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She requires tons and tons every year!

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When the pioneers captured the Ohio salt lands from the Indians, salt sold for a cow and a calf a bushel, it was so scarce. Today one plant of DIAMOND ALKALI is over a salt layer so thick that it is inexhaustible for many generations. Which is fortunate, because practically any industry you can name uses, directly or indirectly, caustic soda or soda ash or chlorine, all made from salt by DIAMOND. Consequently, the present expansion of hundreds of industries becomes an enormously enlarged market for DIAMOND.

THIS ADVERTISEMENT is one of a series appearing in Time, Newsweek and Fortune to broaden public understanding of the part chemicals play in everyday life.

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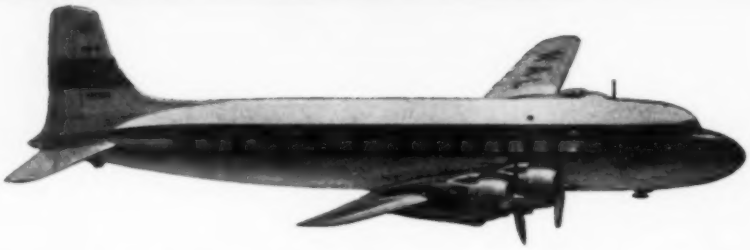
MONSANTO
CHEMICALS — PLASTICS

FOR YOUR INFORMATION

Every month Monsanto publishes these pages of pertinent information which may be helpful to you. This issue discusses:

Additional information will be furnished on request.

SKYDROL... up there with more and more big names!



Since Skydrol® was announced in January 1949, the nonflammable-type hydraulic fluid has won amazing acceptance among the big names of aviation.

Today, every domestic air line flying DC-6's employs Skydrol in cabin superchargers or throughout the hydraulic systems. Skydrol now serves 11 major air lines in planes with total flying hours exceeding a half million. It also is used by a number of overseas lines.

In addition, the new Convair 340's, designed for Braniff International Airways and for United Air Lines, have Skydrol throughout. It is employed in Douglas DC-6B's and Super DC-3's.

Air lines employing Skydrol are: United Air Lines, American Airlines, Italian Air Lines, Delta Air Lines, Cia Mexicana de Aviacion, Panagra, Philippine Air Lines, Braniff International Airways, National, Capital Air Lines and Slick.

Skydrol means greater safety for planes in flight and while they are being serviced. It protects passengers, service personnel and the multimillion-dollar investment in aircraft. Skydrol also is an excellent lubricant. It lengthens the life of hydraulic systems' working parts, brings important savings in maintenance.

Skydrol exceeds the nonflammability requirements of Aeronautical Material Specification 3150 . . has more than double the lubricity of ordinary hydraulic fluids . . . is stable at operating temperatures and pressures . . . is noncorrosive to aircraft metals . . . is nontoxic.

If your company operates a business plane, if you fly your own ship or if you are an air line executive, it will be worth while to get complete information on Monsanto Skydrol. Mail the coupon for a copy of Monsanto's new, 20-page, file-size booklet, "*Skydrol Nonflammable-Type Hydraulic Fluid for Aircraft.*"

Score of railroads use penta wood preservative

More than a score of major railroads are among the hundreds of industries employing Monsanto Penta preservative to make wood last many years longer, thereby reducing maintenance costs.

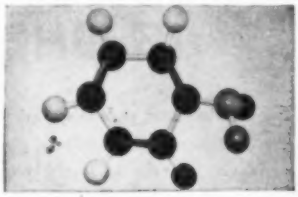
The following table gives the recommended retention of 5% penta solution in pounds per cubic foot:

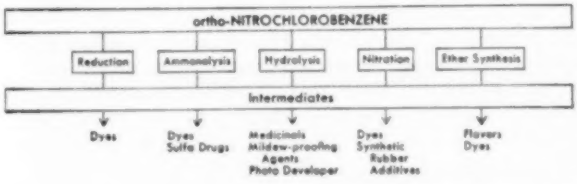
	Humidity average to low	Humidity average high
Sills and plates	6	8
Joists and girders	6	8
Screeds and subflooring	6	8
Factory flooring	6	8
Roof plank	6	8
Platforms and decking	6	8
Posts and fences	6	8
Cooling towers		8-10
Sign material	6	8
Millwork	6	8
Highway guardrails	6	8
Railway cars	6	8
Bridge timbers	8	10-12
Utility poles	8	8-10
Crossarms	6	8

NOTE: Higher treatments are recommended where wood is to serve under severe conditions, such as in the tropics. Recommendations will be furnished on request.

Ortho-NITROCHLOROBENZENE, an "intermediate's intermediate"

Monsanto ortho-NITROCHLOROBENZENE might be called "an intermediate's intermediate" because of its versatility in the manufacture of derivatives which serve as intermediates. Its wide service to industry is illustrated by the following chart:





Ortho-Nitrochlorobenzene has the following physical properties:

Molecular weight	157.56
Standard form	Crystalline mass
Color	Greenish yellow
Crystallizing point	31.7° C. Min.

The versatility of this product indicates numerous applications yet to be discovered. If your research develops new uses, you may be sure of ample supply for production. Qualified chemists may get samples for experimentation by contacting the nearest Monsanto Sales Office or by mailing the coupon.

Milmer 1 controls mildew

Textiles, plastics, leather, insulation and protective coatings can be mildew-proofed efficiently and economically with Monsanto Milmer* 1 (copper 8-quinolinolate-T). Although highly effective against various fungi, Milmer 1 is practically nontoxic to man—is neither a skin irritant nor sensitizer.

Milmer 1 offers long-lasting protection. It is nearly odorless . . . practically insoluble in water . . . stable at temperatures up to 400° F. . . . is exceptionally stable under exposure to sunlight and weather.

Milmer 1 meets many U. S. Government specifications for treated fabrics, including: Mil-D-10860, Mil-T-10168A, Mil-M-5658, Mil-F-4143 and KKL-136-B.

For information, contact the nearest Monsanto Sales Office or mail the coupon.

NOW AVAILABLE

AROCLORS

IN LARGER QUANTITIES

Additional capacity now installed makes the AROCLORS* (chlorinated biphenyl and chlorinated polyphenyls) freely available in larger quantities. For information on their use, contact any Monsanto District Sales Office, or write for any of the following Technical Bulletins: No. P-115, "THE AROCLORS" . . . No. P-124, "AROCLORS as used in chlorinated rubber" . . . No. P-126, "AROCLORS as used in Pliolite S-5" . . . No. P-131, "AROCLORS as co-plasticizers for polyvinylchloride."

Because of the growing recognition of the value of the AROCLORS in many types of chemical processing and formulating, some of the more important applications of these Monsanto chlorinated biphenyl and chlorinated polyphenyls are detailed in the columns at the right.

AROCLORS as used in Pliolite S-5

The AROCLORS are standard plasticizer and resin extenders used to impart desired properties to Pliolite S-5 protective and decorative coatings for application to—Concrete and Steel Structures . . . Railway Tank Cars . . . Concrete Floors and Walls . . . Stucco Construction . . . Wood and Metal Maritime Equipment.

These fast-drying paints provide excellent protection against acids and alkali, moisture and other common corrosive influences.

AROCLORS in die-casting machines

In the nonflammable hydraulic fluid field, particularly in die-casting machines, AROCLOR continues to be recognized as one of the most economical and effective of the nonflammable-type fluids used in transfer service. Die casters wishing to take advantage of the reduced fire hazard provided by AROCLOR, will find no difficulty in conversion. Ask for further information.

TOUGH PAINTS for tough jobs

If you are formulating a metal-surface paint that must be tough enough to resist water, acids, alkali and other corrosive actions, investigate the AROCLORS. They also contribute nonflammability, superior adhesion, high gloss. In addition, they possess good electrical properties.

Among the many uses of the AROCLORS in the coatings field are—Modified and synthetic rubber coatings . . . Lacquers . . . Hot-melt strip coatings . . . Vinyl protective coatings . . . Maintenance paints . . . Adhesives . . . Fire-resistant coatings . . . Wood-sealer formulations . . . Marine paints.

AROCLOR 1248 heat-transfer medium

AROCLOR 1248 (chlorinated biphenyl) is an ideal nonflammable liquid phase heat-transfer medium for temperatures up to 300° C. It has been successfully used for many years with gas-fired units, having capacities in the range of 200,000 to 400,000 B.t.u. per hour—and more recently in much larger units. Other small electrically heated stationary and portable units, with capacities around 40,000 B.t.u. per hour, are also in service.

Some of the more important characteristics of AROCLOR 1248 are—Freedom from fire hazards . . . Viscosities permitting pumping at room temperatures . . . Boiling point sufficiently above 300° C. to assure a liquid condition at all times . . . Stability against heat . . . Controllable vaporization losses . . . General freedom from corrosive action.

For application information, send for Monsanto Technical Bulletin No. P-130, "An Indirect AROCLOR Heater for Unit Chemical Operations."

AROCLORS and biological resistance

Some recent tests which involved the standard screening procedure using the shake-flask method showed that Monsanto AROCLORS exhibited distinct resistance against fungi and bacteria. The presence of this resistance in a commonly used plasticizer indicates that further study of the AROCLORS could prove highly interesting where various types of organism attack are encountered. Excellent termite and other soil mite repellency are additional AROCLOR features.

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MONSANTO CHEMICAL COMPANY, 1700 S. Second Street, St. Louis 4, Missouri. District Sales Offices: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto Canada Limited, Montreal.

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MONSANTO
CHEMICALS — PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

SEND INFORMATION: ☐ Ponta. ☐ Milmer 1.
SEND LITERATURE: ☐ Skydrol.
Technical Bulletins: ☐ No. P-115, The AROCLORS. ☐ No. P-124, AROCLORS as used in chlorinated rubber. ☐ No. P-126, AROCLORS as used in Pliolite S-5. ☐ No. P-131, AROCLORS as co-plasticizers for polyvinylchloride. ☐ No. P-130, An indirect AROCLOR heater for unit chemical operations.
SEND SAMPLE: ☐ Ortho-Nitrochlorobenzene.

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Name.....Title.....
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REGISTERED TRADE MARK

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Beat it with this Bonderized pair

You can install this Life-Line chemical motor and Life-Linestarter® team, any place and be sure. They're tough, dependable. Extra-protected, inside and out, and Bonderized to beat off corrosion's attacks. Look at the motor, for example.

Its specially treated, rolled-steel frame constantly has proved its ability to outlast conventional frames. Why?

In the first place, the frame is heavy-gauge, Bonderized steel. Then, special formaldehyde-alkyd-type enamel and succeeding layers of Thermoset varnish plus final lacquer are applied. That makes a tough hide to ward off corrosion's sabotage.

Too, Life-Line pre-lubricated, factory-sealed bearings guard against acid and other bearing enemies. This one feature alone has doubled bearing life . . . multiplied it many times in some plants. Lubrication maintenance is eliminated.

Life-Linestarters are also Bonderized—the only standard Bonderized starter available today at no extra cost. That's why, in corrosive atmospheres, the Life-Linestarter has rendered substantial savings to users. In places where local electrical codes formerly specified expensive, hot-dipped galvanized or cadmium-plated enclosures, the Life-Linestarter is now acceptable.

Together, you can't beat this team for corrosion resistance. Put them together on your applications and save. Discuss the details with your Westinghouse representative. He has the facts to help you stop corrosion raids. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21630

YOU CAN BE SURE.. IF IT'S Westinghouse

Life-Line

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Announcing a New

INTERNATIONAL

headline achievement–a truly sensational step in the science of Chemical Mixing–a new and important concept in the field of Fluid Agitation . . .

The INTERNATIONAL STABILIZER-BAFFLE stems from International's pioneering research in the Science of Mixing as a basic Chemical Engineering Unit Operation. • It prevents ineffective mass rotation and creation of a liquid vortex. • It induces top-to-bottom turnover instead of non-useful horizontal swirl. • It is an anti-settling and anti-layering device, improving the flow pattern produced by helical propeller type mixing elements.

The INTERNATIONAL STABILIZER-BAFFLE eliminates the whipping of free-end suspended vertical mixer shafts, with no appreciable side thrust exerted on the shaft. It prevents shaft failures which would otherwise occur from critical speed considerations. It makes possible the use of long thin shafts, up to 10 ft. in length, without the use of steady bearings or step bearings. It eliminates the need for submerged bearings with their attendant maintenance and repair problems. Consumes little space and need not rest on the bottom of tank. Thus, there is not the usual "dead" volume as with ordinary tank baffles. It can be readily removed for cleaning purposes, if necessary. Informative Literature sent on request.

These two photographs illustrate the startling difference in flow pattern, occuring with and without the INTERNATIONAL STABILIZER BAFFLE, under exactly the same conditions. The shaft speed, propeller and rheological properties of the mix being the same in both cases . . . Impeller is center-mounted operating Counterclockwise at 1750 RPM. Turnover and overall Agitation in above photograph is effected by splitting of helical stream, causing the flow to follow a radial path to the tank wall, and thence upward.

The International

STABILIZER BAFFLE

ELIMINATES MIXER SHAFT WHIP—AND LIQUID VORTEX

INTERNATIONAL MIXERS are now being used throughout the world for all industrial applications. They are available in all metals and contings and for all power sources or current characteristics.

INTERNATIONAL sales engineers are available in your area to help you with your mixing problems. These sales engineers are right behind the International performance and workmanship guarantee.

Above photograph shows the deep vortex and poor solids distribution, without the INTERNATIONAL STABILIZER BAFFLE. Note that there is little top to bottom turnover and inefficient flow pattern.

INTERNATIONAL ENGINEERING, INC.

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WORTH 2-2580

DAYTON 1, OHIO

CHICAGO
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WABASH 2-0733

MEMO

INTERNATIONAL ENGINEERING, INC.
DAYTON 1, OHIO

Please send literature checked below:

- ☐ TECHNICAL SUPPLEMENT No. 111 ON STABILIZER-BAFFLE
- ☐ CATALOG 74 ON PORTABLE MIXERS
- ☐ CATALOGS 73 & 76 ON TOP AND SIDE ENTERING AGITATORS
- ☐ CATALOG 120 ON CHEMICAL PROCESSING EQUIPMENT

Name _____

Title _____ Company _____

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Memo from the Editor **John R. Callaham**

Keeping Tabs on Technology

It's exciting work to smell out and go after new technical developments and to report them to you while they're still timely. On each new development we try to get the answers to three questions:

- **What's the new—or newsworthy—slant on it?**
- **What does it mean and why is it important?**
- **What's its technology and how does it work?**

Sure, and it's tough work, too, to dig up stories on new technical developments. I can tell you that precious few just come in—we have to go out and dig them up the hard way (which is why a lot of them are "firsts" in print). But that makes it more fun.

Here, for instance, is a glimpse at the stories-behind-the-stories on some of the items we've tackled recently. The same sort of story could be told on a lot of our items and articles.

▶**Hot Stuff in Electronics**—Several months ago we began to hear a little about germanium and "the coming transitor revolution in electronics." But we really picked up our ears when Dr. R. M. Burns of Bell Laboratories dropped a remark about a brand new field that'll "rival the chemical industry in size."

I had a vague idea what germanium was but I didn't know a thing about transitors. I asked News Editor Joe O'Connor.

"I don't know either," Joe said, "but I'll find out." Now Joe's a curious Irishman with the stubbornness of an English bull-dog when it comes to digging out hard-to-come-by facts.

Don Fink, editor of *Electronics*, just back from Belgium, told us that transitors were really hot. "Go after General Electric, Bell, Sylvania, Signal Corps," Don told Joe.

So out went the telegrams, telephone calls, letters. "Sure, I'll round up something for you—but give me a little time," came back GE's E. M. Trefethen. "I'll also ask Robinson to round up something for you."

"Why don't you come over to our place and talk to our people?" said Dr. Burns, chemical director of Bell Labs. It was the Bell people who did the pioneering work in transitor development.

"Drop down and visit us next Friday," came back the Sylvania people. Joe spent the better part of a day with Sylvania engineers and physicists (and lugged back a frightening book called *Electrons and Holes in Semi-Conductors*).

John Kent of our Washington office tackled Army's Signal Corps. "We'll give you our slant and a picture or so," was the answer.

John also went after the Bureau of Mines and other people in Washington. Most of them just mumbled something about "No comment; security stuff, classified, you know." Which is a lot of hogwash, of course, but quite a fad right now among bureaucrats.

But what about germanium itself, key to the whole business? "Talk to the Eagle-Picher people, they're the biggest producer," advised Editor Bob Ramsey of *Engineering & Mining Journal*. "I think we've got what you want on prices and how much is being turned out."

So Joe talked to Dr. John Musgrave down in Joplin, Mo. It was Eagle-Picher's men who years ago pioneered germanium recovery from lead-zinc ores. "You want to talk to our Mr. E. L. Goudey at headquarters in Cincinnati, too" Dr. Musgrave said.

"I've got what you want, all right," he said, "and I'll do my darndest to persuade our people to let you have it. But give me a little time, please."

Then we heard that the British were busy as beavers, too. Seems that British GE had done some work at Toddington on getting germanium out of coal flue gases.

So we called Nat McKittrick, our news representative in London. Nat went to work and within a week we had his part of the story.

Then came the time when Joe had to get his facts together and write the story. How the poor fellow sweated over those electronic theories (especially the theory of holes, which I gather is somehow pretty vital to the whole development).

Why did we go to so much trouble to get this story on germanium (which you'll find on page 158)?

Because we're convinced that some day, somehow, the germanium transitor will have a big impact on process instrumentation and the chemical industry. And besides, we believe you wanted to learn about this important development early in the game—when it's timely.

▶**What're Bentones?**—Then there's the piece we ran last month (p. 226) on Bentones and Baroid's process for making these unusual chemical compounds.

Last fall Jack Shinn, our man down in Los Angeles, talked to somebody and picked up the fact that the Bentones are going over like wildfire.

Jack tipped off Elliot Schrier, our West Coast Editor in San Francisco Elliot teletyped us to get in touch with Mellon Institute in Pittsburgh. Process work was done there and he'd heard that the Mellon people were operating a commercialized pilot plant.

Meanwhile, we talked to National Lead's Dr. Retti in Brooklyn. "The man to give you the dope on what Bentones are used for is our Malcolm Finlayson in Pittsburgh," he said. So back to Pittsburgh we went.

By that time we'd learned that the plant had been moved to Houston and that a new one had just been put up there. Houston's in the territory of Jim Lee, our Southwest Editor.

Finally we got our man—Dr. F. J. Williams, Baroid's director of research in Houston. Dr. Williams worked up the process story and flowsheet, had a photographer take the plant pictures. Malcolm Finlayson in Pittsburgh gave us the market picture.

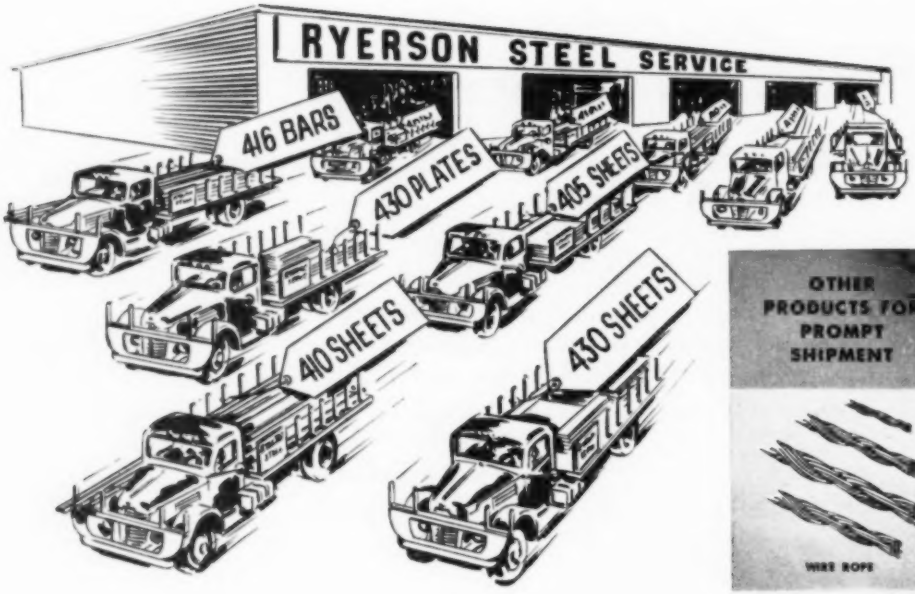
About the time we'd finished the story, Dr. Williams happened to be in New York. He came over to the McGraw-Hill building, read the story and personally checked the flowsheet drawings.

That's how we got the story on Bentones, those novel gelling agents made from bentonite clay and organic amines. You'll be hearing more about them.

▶**New Type Furnace**—I'm sure, though, that the toughest stories are those that come from foreign countries. Here's the story-behind-our-story on the Elkem carbide furnace (March, p. 238).

Back in July we heard that National Carbide was going to put up a big carbide plant in Kentucky. And that a

(*Continued* on page 315)



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Straight Chrome in Every Gauge & Size

As stainless users switch to straight chrome types, Ryerson is ready for them. Ready with the nation's largest and most diversified stocks of straight chrome stainless steels.

Our stocks are large because we began building them months ago —when it first became evident that the use of nickel would be restricted. As a result, you can maintain your stainless production now, despite restrictions, by calling Ryerson.

All the straight chrome steels shown on the tags above are on hand in a wide range of gauges and sizes. So we are in a good position to handle almost any requirement. And all are time-tested Allegheny stainless steels of definitely established performance.

If you are looking for a metal to replace nickel-bearing steels, we urge you to consult our stainless specialists. Then draw on our large stocks of straight chrome types. A special technical bulletin on chrome stainless alternates for various applications of 18-8 stainless has just been published. Write for your copy.

Warehouse Distributor of Allegheny Stainless in All Types, Shapes and Sizes

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JOSEPH T. RYERSON & SON, INC. STEEL-SERVICE PLANTS AT: NEW YORK • BOSTON PHILADELPHIA • DETROIT • CINCINNATI • CLEVELAND • PITTSBURGH • BUFFALO • CHICAGO MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE

SIDNEY D. KIRKPATRICK, Editorial Director *JOHN R. CALLAHAM, Editor*

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING

APRIL 1952

Research Is Big Business—for Uncle Sam

Are you surprised to know that our 1952 bill for research and development will average more than $20 per person for each of our 150,000,000 U. S. citizens? You may argue that if we're spending $8 billion for foreign aid, why quarrel over a mere $3 billion for searching out new knowledge in science and engineering?

But the problem beginning to alarm many of us is how to keep the camel's nose from upsetting the research tent.

Today, the federal government is footing the bill for more than half of all research activities in the United States. Only about $1.3 billion will be privately financed by institutions, universities and industry.

Does this mean, as some infer, that research and development in this country is already more than half socialized? Does it mean that Uncle Sam will soon be in a position to call the tunes while our research scientists and engineers dance to military music?

Dr. W. R. G. Baker, electronics chief for General Electric, is one of those who feel that the time has come for a "wholehearted investigation to determine the overall efficiency and extent of duplication of governmental research and development." And he urges the National Science Foundation to select outstanding engineers from industry and education to conduct this investigation.

We may find some consolation in the fact that only about 50 percent of the research expenditures by federal agencies is for work actually done in government laboratories. The remainder is performed on contract for the federal government—about $600-million in the case of industry and $185-million for the universities.

This practice, which largely had its beginnings during World War II, has many advantages. It helps to train and develop sorely needed research personnel. It provides a broader base of operations, hence more diversified sources of ideas and fundamental data. And it is better for the national economy in the long run for the government to sponsor temporary projects rather than to establish self-perpetuating bureaucracies. When depressions come or appropriations for the defense agencies are slashed, we can be sure that the first contracts to be cancelled will be those with industrial and university laboratories.

As engineers, as well as taxpayers, we have an important stake in research. It is not always appreciated, especially in the National Science Foundation, but some 15 percent of America's 415,000 engineers are in research and development work. Approximately 47 percent of these are being paid at present from Uncle Sam's military budget.

And the Engineering College Research Council has recently pointed out that the chemical engineering departments in our universities are supplying Uncle Sam with the services of 735 faculty members and full-time research associates in addition to 1,700 graduate students and assistants engaged in government-sponsored research. This is said to be a higher proportion of the total qualified personnel than in any other of the physical and engineering sciences. Chemical engineers account for but 3 percent of the engineering faculties, but they are doing 4 percent of all college and university research in this field.

Chemical process industries, probably more than any other group, are dependent on research. Those who manage our enterprises, therefore, have a serious obligation to keep our research machine operating efficiently and economically.

Unnecessary duplication and wasteful expenditures for facilities and projects must be avoided. Likewise, we should not permit our government permanently to rob our industries and universities of research personnel sorely needed for the survival of private enterprise.

But at the same time, let's recognize the fact that especially in periods of emergency, many vital research projects can be carried out only by the federal government. Our obligation as engineers and managers is to see that they are done most efficiently and that in the end we do not surrender our franchise to a burgeoning bureaucracy.

Sidney D. Kirkpatrick

Cost and Performance of Centrifugals

Here's up-to-date information on: 1. Purchase prices, installation costs. 2. Operating labor and maintenance. 3. Performance and capacity figures.

JULIAN C. SMITH

In the past few years several articles[1, 2, 3, 4] have discussed the investment and operating costs of centrifugal separators. The somewhat scattered information they contain is now out-of-date, partly because construction costs have risen steadily, but also because of changes and improvements in the performance of the various machines.

The purposes of this article are to correlate the published data with additional information from the manufacturers and to give a more complete and up-to-date picture of performance characteristics, purchase and installation costs, power, operating labor and maintenance costs of centrifugal separators.

Centrifugals play many roles in modern processing, and very different machines are used for various functions. There are four main types:

1. High-speed centrifugals with bowls of small diameters are used principally for liquid-liquid separations and for clarifying liquids; modified high-speed machines can continuously separate more-or-less dry solids from one or two liquids.

2. Batch centrifugals wash and "dry" crystals, powders, textiles and other solids.

3. Small completely automatic batch machines, dewatering coarse crystals on very short batch cycles, are extensively used in continuous processing; larger ones are sometimes used for fine powders and sludges.

4. Truly continuous conveyor centrifugals dewater both coarse and fine solids. For coarse crystals, reciprocating conveyor machines are used; for both crystals and sludges, scroll conveyor centrifugals find increasing application.

Detailed descriptions of the commercially available centrifugals and methods of selecting one for a particular service have been published in recent years.[5, 6, 7]

J. C. SMITH is associate professor of chemical engineering at Cornell University, Ithaca, N. Y. Readers of Chemical Engineering will remember his report on "Glass" which appeared a year ago this month. Watch for another of his reports soon.

CAPACITY, POWER AND PURCHASE PRICE

Throughput capacity and power requirements of a given centrifugal separator depend on the difficulty of the separation problem. They vary over a considerable range for all centrifugals and over a very wide range for some types. Thus the information given here should be considered as representative, but by no means limiting or exact. Investment correlations are based on purchase price, because for most types of centrifugals the purchase prices of the various sizes have been standardized. All costs have been adjusted to the March 1952 *Engineering News-Record* Construction Cost Index of 550 (1913 = 100).

High-Speed Small-Diameter Centrifugals—In this type in particular, enormous differences in capacity result from changes, even minor ones, in the properties of the materials handled. The same machine often processes ten times as much of one liquid as it does of another. The purchase prices vary, too, depending on size, material of construction, accessories and portability of the machine. Vapor-tight portable separators are more expensive than open stationary ones.

Typical performance data and purchase prices are given in Tables I and II, along with indications of the factors influencing the prices of individual machines.

Batch Centrifugals—Top-suspended batch centrifugals with perforated baskets are used for dewatering crystals and fine powders; base-bearing and

Table I—Power Loads and Typical Capacities of High-Speed Centrifugals

Type	Material Handled	Power Load, Hp.	Typical Throughput Capacity, Gal./Hr.
Tubular	Transformer oil	—	1,200
	Diesel lube oil	2	350
	Olive oil and water	2	200
	Organic chemicals	—	40–400
Disk	Turbine oil	—	1,000
	Vegetable oil	—	450
	Lube oil	1½	100–150 (small)
		2	225–250 (large)
	Organic chemical liquids	—	40–70 (small)
		—	300–500 (large)
3-Way separator (Sharples Autojector)	Wool grease from scouring liquor	18	1,800

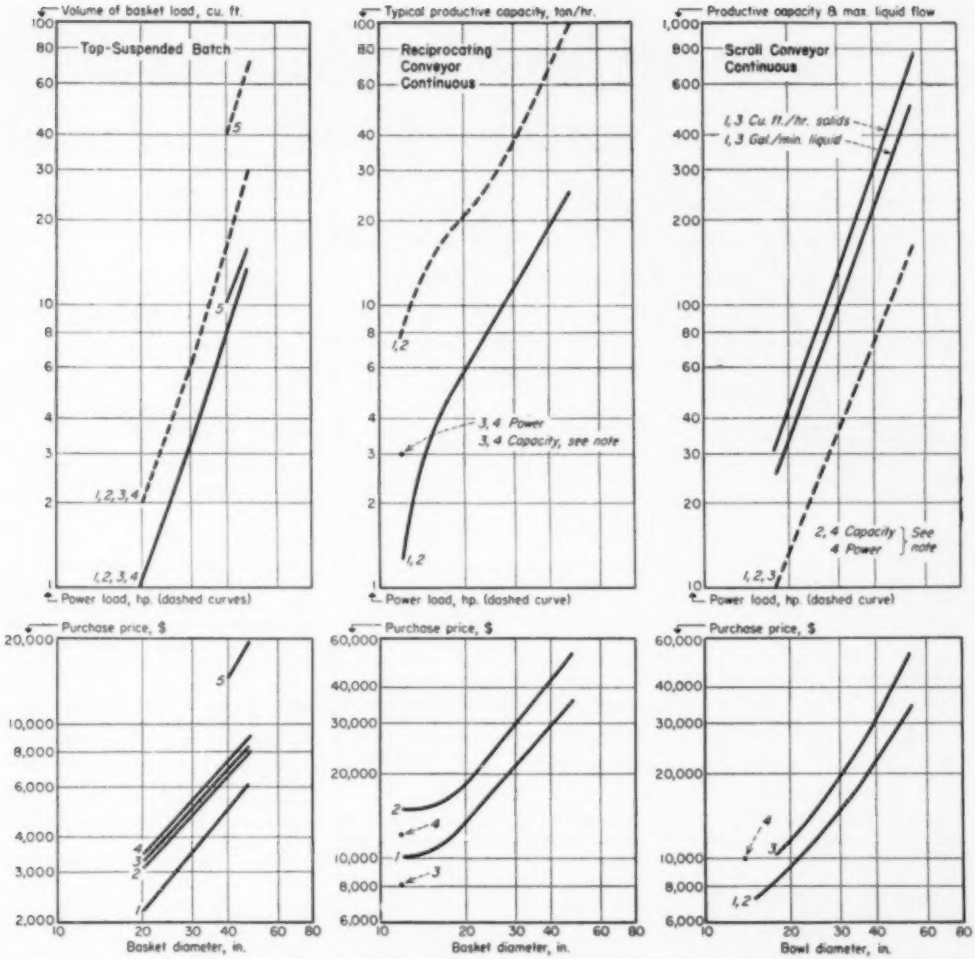
Table II—Costs of High-Speed Centrifugals

Type	Diameter of Bowl, In.	Designation	Approx. Purchase Price, $	Remarks
Tubular	4 to 6	Marine oil purifier	1,600–5,300	Cost depends on size.
		Oil purifier, steel	1,500–3,500	Cost depends on size and enclosure.
		stainless steel	2,800–6,400	
		Varnish, lacquer and enamel clarifier	3,500	Stationary.
			4,700	Portable.
		Blood plasma separator	5,000	———
		Insulating oil purifier	6,400	Small, stationary.
			10,400	Large, portable.
Disk	11 to 19	Sharples DD-2	5,000–8,000	Cost depends on material of construction and enclosure.
		Oil purifier	2,000–2,500	Small.
			2,500–3,500	Large.
		Turbine oil purifier	5,000	———
		Chemical separator	2,000–2,500	Small, steel.
			5,000–6,000	Large, stainless steel.

Table III—Typical Capacities of Basket Centrifugals

(Basis: 40-in. basket diameter; 7.8 cu. ft. per load)

Product	Cycle Time, Min.	Basket Load, Lb.	Capacity, Tons/Hr.
Top-Suspended Machine			
Sugar	2–5	350–500	2–5
Inorganic salts	10–15	350–700	0.7–2.5
Organic crystals	10–20	250–350	0.4–1.0
Fine powders	30	350	0.35
Link-Suspended Machine			
Waste	10	80	0.4
Textile piece goods	15	70–120	0.13–0.25



(1) Steel; (2) Rubber covered; (3) 304 stainless; (4) 316 stainless; (5) Sugar machines, electric or fluid drive, with automatic cycle timers, also automatic discharge on 48-in. machine. For cost of imperforate baskets, fume hoods, etc., see text.

(1) Steel; (2) Stainless steel; (3) Small Model S-12SB, steel; (4) Small Model S-12SB, stainless steel. Capacity is based on ammonium sulphate, 40 percent solids in feed slurry, 90 percent coarser than 100 mesh. S-12SB processes 0.32 ton per hr.

(1) Bird, steel; (2) CSE, steel; (3) Bird, stainless steel; (4) Sharples Super-D-Canter, stainless steel. 15-in. CSE machine processes ¼-1 ton solids per hr.; 36-in., 6-15 tons per hr. Super-D-Canter handles 20-40 gpm. feed and draws about 8 hp.

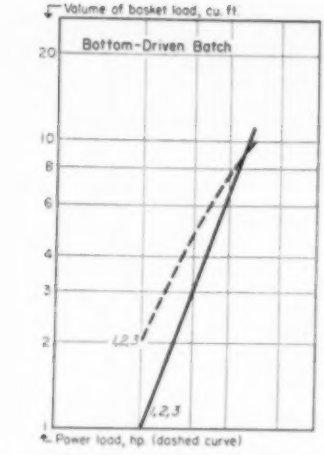
link-suspended machines handle such things as pharmaceuticals, textiles and metal chips. Power required, volume of solids handled per basket load, and purchase price of representative makes of top-suspended machines are shown graphically above, and similar graphs for base-bearing and link-suspended centrifugals are given in the graph on p. 142 labeled "Bottom-Driven Batch."

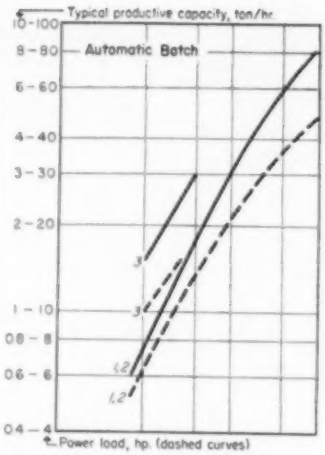
Productive capacity of a batch centrifugal depends on the density of the solid cake and the time required per load. Sugar machines handle fairly heavy loads on 2 to 5 min. cycles, often with no washing; they have high capacity and require considerable power. In other services, 2 to 6 loads per hr. are common, and less power is needed. Representative cycle times, basket loads and capacities are given in Table III.

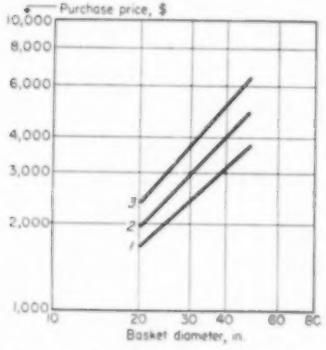
Top-suspended centrifugals with imperforate bowls are used for removing fine solids and sludges from fairly large quantities of liquids. Such machines cost about 10 percent more than similar machines with perforated baskets.

With both perforated basket and imperforate bowl centrifugals a fume hood adds about 15 percent to the purchase price. With centrifugals having baskets 20 to 32 in. in diameter, an explosion-proof motor adds 15 percent to the cost of the machine in steel construction; with 40-in. and 48-in. machines, it adds 35 percent to the cost of the machine in steel.

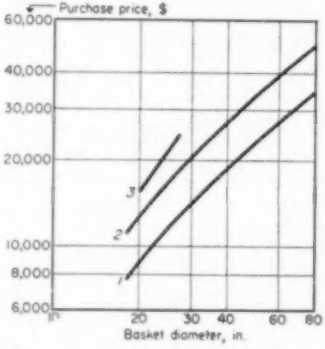
Batch-Automatic Centrifugals—The Sharples Super-D-Hydrator is designed to handle fairly coarse crystals







(1) Steel; (2) Rubber covered; (3) Stainless steel. 20-26-in. machines are base-bearing; 30-48-in., link-suspended.



(1) Baker Perkins automatic, steel; (2) B-P, stainless; (3) Sharples Super-D-Hydrator, stainless. For capacity, see text.

(typically 100 to 150-mesh minimum size) on batch cycles of 35 sec. to about 3 min. It is made with basket diameters of 20 and 27 in. Baker-Perkins automatic machines process finer solids and may require canvas filter media and longer batch cycles. They are made with basket diameters from 18 to 81 in.

Typical power requirements, capacities and purchase prices are given in the appropriate graph. Capacities of Baker Perkins machines are based on feed slurry containing 20 percent of crystals, of which 60 percent are coarser than 200 mesh and 89 percent coarser than 400 mesh, with a discharged cake containing 13.5 percent moisture. Capacity of Super-D-Hydrators is based on feed containing 30 percent solids, with 90 percent coarser than 150 mesh.

Capacities are average values only; a 20-in. Super-D-Hydrator, for example, may handle between 0.2 and 2.5 tons per hr., and the 27-in. machine processes 6 tons per hr. of some materials. Purchase prices are also typical values, but the ranges are narrow. Special cycle timers, additional valves to separate filtrate from discharged wash liquor, special discharge chutes and hoods increase the cost to about $17,000 for a 20-in. Super-D-Hydrator and to about $27,000 for the 27-in. machine.

Continuous Conveyor Centrifugals—Performance data and purchase prices of reciprocating conveyor and scroll conveyor solid-bowl centrifugals are presented graphically on the preceding page.

Reciprocating conveyor machines handle coarse crystals only; solid-bowl scroll conveyor centrifugals operate on both crystals and sludges. With dilute feeds the capacity of scroll conveyor machines is limited by the liquid throughput; with concentrated slurry feeds, the solids-handling capacity is the limiting factor.

Bird Machine Co. also makes a 24-in. screen-bowl conveyor centrifugal which handles from 2 to 4 tons per hr.

INSTALLATION COSTS

Typical installation costs are given in Table IV, in most cases as ranges, with some information regarding the factors influencing the cost. Many machines are shipped virtually as packaged units and require only piping, wiring, and possibly a small foundation. Examples are portable high-speed centrifugals and bottom-suspended batch centrifugals. Other machines, notably top-suspended batch centrifugals, require extensive foundations and auxiliaries, so that the installation cost may equal the purchase price of the machine.

Where provision must be made for feeding or discharging viscous liquids or tars, or for keeping heavy slurries of crystals well agitated during feeding, installation costs mount rapidly.

(*Continued on page 147*)

Table IV—Installation Costs

Type	Installation Cost, % of Purchase Price	Installation Includes
High-Speed		
Tubular	6	Piping, foundation and wiring, but excludes accessories.
Disk	6	
3-Way separator	11	
Batch		
Top-suspended	80	Wiring, minimum piping; floor-level installation; no accessories.
	100*	Elevation 15 ft. above floor level; extensive piping; discharge chutes.
Base-bearing or Link-suspended	10-15*	Piping, wiring; flat concrete pad; no discharge facilities required.
Batch Automatic		
Baker Perkins	15-20*	Foundation, wiring, and reasonable amount of piping.
Sharples Super-D-Hydrator	10	Foundation, wiring and piping, but no accessories.
Continuous Conveyor		
Reciprocating	15-20*	Foundation, wiring, and reasonable amount of piping.
Sharples Super-D-Canter	7	Foundation, wiring and piping, but no accessories.
Bird	10-25*	Foundation, wiring and piping.

*Percent of cost of machine in steel construction. Actual installation cost—not percentage of purchase price—of corrosion-resistant machine must be increased because of higher piping cost, but costs of foundation and wiring remain the same.

Statistics Can Put More Meaning Into Your Cost Estimates

How do you define the accuracy of an estimate? How can accuracy be improved? When are uncertainties additive? When are they compensating? Here's how you can tell.

PAUL FERENCZ

Many important decisions are based on cost estimates. In order to exercise proper judgment, the people who make such decisions must know the reliability of these estimates. This article shows how to figure the probable accuracy of a cost estimate, using a statistical approach. It will enable you to draw more realistic conclusions for the decisions you have to make.

Estimates are necessarily based on certain available information. If you have no information, you can't make an estimate; if the information is complete, you don't need to make an estimate. Every observation is a sample of the values which may actually occur.

As usually prepared, estimates represent only expected averages. They do not reveal anything about the probability of finding the actual results within certain limits above and below the expected averages. Every estimate, however, is a statistical concept characterized by a mean value and a standard deviation and should be treated as such by the methods of statistics.

WHAT IS AN ACCEPTABLE RISK?

In order to treat estimates as statistical concepts we must define numerically what we consider to be the acceptable risk of our actual value being outside the stated limits. That definition is, to some extent, an arbitrary one. For most cost estimates we are safe in defining our limits so that the probability of finding the actual value between the limits is 99 percent. According to statistical tables for normal distribution curves, this definition fixes the standard deviation σ as equal to the interval between the limits divided by 5.2. When the estimate is based on a series of observations the value of σ can be directly computed by usual statistical methods.

DR. P. FERENCZ *is a chemical engineer with Canadian Industries Limited, Montreal. He feels very strongly that chemical engineers can make better use of mathematical tools, especially the science of statistics.*

Theoretically, normal distribution for cost data is approached more closely when using logarithms of the values instead of the values themselves. This is because, when a series of values is limited at one end, the distribution is bound to be more or less unsymmetrical. And cost data, of course, are limited at the zero end. For practical purposes, however, logarithms are seldom necessary. If your information is precise enough, the deviation will be small, and if the information is very rough, using logarithms won't improve the precision significantly anyway.

A complete project analysis, based on estimates of construction and operating costs, sales volume, etc., involves the mathematical combination of many individually estimated items. Without the benefit of statistics, the expected averages are added, subtracted, multiplied and divided by simple arithmetic. In order to apply statistical analysis, however, we must calculate the resulting standard deviation every time we mathematically combine two or more estimated quantities.

Two more definitions are necessary before we proceed with the formulas for carrying out the desired operations. The square of the standard deviation, σ^2, appears in the several formulas and is called the variance.

The term r denotes the correlation coefficient. When a change in the value of one item involves a change in the value of another item, the values of the two items cannot combine in every random way; the number of combinations is restricted by some relationship between the two items.

CORRELATION OF VARIABLES

If the relation between the two items is strictly proportionate the correlation is said to be perfect. If the proportion is direct, r has a value of $+1$; if it is inverse, r is -1. Where there is no correlation, r is 0, and for intermediate cases r can be any value between -1 and $+1$.

In case of imperfect correlation the value of r can be calculated by the formula:

$$r_{ab} = \frac{(\sigma_b^2 - \sigma'^2_b)^{\frac{1}{2}}}{\sigma_b} \qquad (1)$$

where σ_b is the standard deviation of all possible values of b and σ'_b is the standard deviation of those b values which might arise when the value of a is held constant.

Let's assume a simple illustrative example involving a compressor and its prime mover or driver. The compressor will cost somewhere between \$8,000 and \$12,000 and its driver from \$2,000 to \$3,000. We want to combine these figures to get the cost of compressor and driver together, expressed in terms of lower and upper limits.

Case I: We have exact quotations on several sizes of compressors and drivers of a given type; we are uncertain as to just what sizes we shall use. The correlation is assumed to be perfect and direct—the smaller (and cheaper) compressor will require the smaller (and cheaper) driver. The limits are, logically, \$10,000 and \$15,000, with no chance for bringing them closer by offsetting effects.

NOMENCLATURE

μ	= Mean value
σ	= Standard deviation
σ^2	= Variance
r	= Correlation coefficient

Subscripts

a, b	= Individual items
c	= Cost per ton of product
C	= Annual cost
e	= Percent return on investment
E	= Annual earnings or profit
F	= Fixed investment
g	= Natural gas
I	= Total investment
k	= Coke
K	= Product inventory in stock
p	= Price per unit
P	= Annual production
q	= Quantity per ton of product
R	= Annual realization
s	= Selling price of product
S	= Annual sales volume
W	= Working capital

Case II: We have exact quotations on several types of compressors and drivers of a given size; we are uncertain as to just what type we shall use. The correlation is assumed to be perfect and inverse—the cheaper type of compressor will require the more expensive type of driver, and vice versa. The limits are, again by logical inspection, $11,000 and $14,000. Here the uncertainties are obviously reduced by compensating effects.

Case III: More often we specify the size and type of compressor and driver; our uncertainties arise from lack of exact cost data. If we assume no correlation at all, our limits become $10,440 and $14,560. Here we have a partial compensation due to the probability of our uncertainties offsetting one another. The limits correspond to our original definition of 99 percent probability.

EQUATIONS FOR STANDARD DEVIATIONS

In these examples we use this formula for the standard deviation of the sum of two values:

$$\sigma_{a+b} = (\sigma_a^2 + \sigma_b^2 + 2r_{ab}\,\sigma_a\,\sigma_b)^{\frac{1}{2}} \qquad (2)$$

For the compressor, $\sigma_a = 4{,}000/5.2 = 770$, and $\sigma_a^2 = 593{,}000$. For the driver, $\sigma_b = 1{,}000/5.2 = 193$, and $\sigma_b^2 = 37{,}000$. The product $2\sigma_a\sigma_b = (2)(770)(193) = 29{,}700$. Since r is $+1$, -1, and 0, respectively, for the three cases, this latter term becomes $+29{,}700$, $-29{,}700$, and 0.

For Case I, $\sigma_{a+b} = (593{,}000 + 37{,}000 + 29{,}700)^{\frac{1}{2}} = 960$. The interval between the limits then $= (960)(5.2) = 5{,}000$, or 2,500 above and 2,500 below the mean value of 12,500. The intervals between limits are found similarly for Cases II and III to be 3,000 and 4,120.

Where we want the standard deviation of the sum of three values Eq. (2) becomes:

$$\sigma_{a+b+c} = (\sigma_a^2 + \sigma_b^2 + \sigma_c^2 + 2r_{ab}\,\sigma_a\,\sigma_b + 2r_{ac}\,\sigma_a\,\sigma_c + 2r_{bc}\,\sigma_b\,\sigma_c)^{\frac{1}{2}} \qquad (3)$$

and so on for more than three values.

Standard deviation of a difference:

$$\sigma_{a-b} = (\sigma_a^2 + \sigma_b^2 - 2r_{ab}\,\sigma_a\,\sigma_b)^{\frac{1}{2}} \qquad (4)$$

Eqs. (2) to (4) apply to linear scales. If the standard deviation of each component has been calculated on a logarithmic scale you must convert the logarithmic probability curves into the most fitting linear ones and use the standard deviations of the linear curves for calculating sums and differences. There is no simple mathematical way to express $\log (a + b)$ in terms of $\log a$ and $\log b$.

FOR PRODUCTS AND QUOTIENTS

Standard deviation of a product:

$$\sigma_{ab} = (\mu_a^2\sigma_b^2 + \mu_b^2\sigma_a^2 + \sigma_a^2\sigma_b^2)^{\frac{1}{2}} \qquad (5)$$

Table I—Cost Estimate for Projected Ammonia Plant

	Mean Value $/Yr.	Variance X 10^6 Total	Variance X 10^6 Depending on Production	Remarks
Realization	2,255,000	7,242	6,236	Sales: 25,000–30,000 tons/yr. Price: $79–85/ton. Storage capacity: 4,560 tons.
Natural gas	57,200	3.2	0.3	24–28 M cu. ft./ton NH_3. 7.5–8.5 c./M cu. ft., decreasing at larger consumption
Electric power	163,500	19.4	5.6	800–900 kwh./ton NH_3. 830–870 kwh./ton NH_3 if the gas quantity per ton NH_3 is taken as constant at its mean value. Price: 0.7 c./kwh.
Steam, water	34,400	7.3	0.3	$1–1.50/ton NH_3.
Catalysts, supplies	99,000	42.2	2.0	$3–4.20/ton NH_3.
Labor	302,500	131.0	19.0	$10–12/ton NH_3.
Repairs	235,000	45.0	11.5	$220,000–250,000/yr. at average production.
Supervision	55,000	3.7	....	$50,000–60,000/yr.
Depreciation	258,450	4.2	....	5% of fixed investment.
Other indirect costs	320,000	80.7	21.4	$300,000–340,000 at average production.
Correction for correlation between gas and electric power	.....	15.3	....	
Total costs	1,525,050	352.0	60.1	
Profit	729,950	6,370		σ = 79,810
Fixed investment	5,169,000	1,670		
Working capital	300,000	24.3		
Return on total investment	13.35%			σ = 1.45%

This equation, and also Eq. (8) below, are implicity given in formulas of higher mathematical statistics. A relatively simple direct derivation is possible.*

Eq. (5) applies to linear scales. On logarithmic scales it would be:

$$\sigma_{\log ab} = (\sigma^2_{\log a} + \sigma^2_{\log b})^{\frac{1}{2}} \qquad (6)$$

The same formula can also be applied for a quotient:

$$\sigma_{\log a/b} = (\sigma^2_{\log a} + \sigma^2_{\log b})^{\frac{1}{2}} \qquad (7)$$

since $\log 1/b = -\log b$, and $(-\log b)^2 = (\log b)^2$.

Eq. (6) follows simply from $\log a + \log b = \log ab$. Here a correction $2r\sigma_{\log a}\sigma_{\log b}$ can be added to allow for correlation. The same correction would apply to Eq. (7), in which case the correlation term would be negative.

Eq. (5) is especially useful. In the case of cost estimates the last term on the right is always very small compared with the other two terms and can usually be neglected. The variance of the product, therefore, is given as the sum of two variances, the first depending only on the standard deviation of component b and the second on that of a, inasmuch as the mean values of a and b can be considered as constants.

The following equation can be used for calculating on a linear scale the standard deviation of a product when the two values are correlated:

$$\sigma_{ab} = [\mu_a^2\sigma_b^2 + \mu_b^2\sigma_a^2 + \sigma_a^2\sigma_b^2 + r\,(2\mu_a\,\mu_b\,\sigma_a\,\sigma_b + r\,\sigma_a^2\,\sigma_b^2)]^{\frac{1}{2}} \qquad (8)$$

Neglecting terms involving $\sigma_a^2\sigma_b^2$, for cases involving perfect correlation, either direct or inverse, Eq. (8) simplifies to:

$$\sigma_{ab} = \mu_a\sigma_b + r\,\mu_b\,\sigma_a \qquad (9)$$

where r is $+1$ or -1 and σ_{ab} is always positive.

ILLUSTRATIVE EXAMPLE

Statistical analysis and interpretation of a cost estimate is illustrated by the following hypothetical case:

A company could use either natural gas or coke as raw material for making ammonia. A cost estimate based on the use of natural gas is shown in Table I. It has been carefully prepared without bias. The estimator

* For sake of brevity, Dr. Ferencz' derivations of Eqs. (5) and (8) have been omitted. He has indicated his willingness to send interested readers copies of these derivations, upon request either through *Chemical Engineering* or directly to him. —Editor.

Table II—Summary of Cost Estimate for Alternate Plant Using Coke

	Mean Value $/Yr.	Variance	Standard Deviation
Total costs	1,400,000	315×10^6	17,800
Profit	830,000	315×10^6	17,800
Total investment	6,000,000	$4,225 \times 10^6$	65,000
Return	13.75%		

used average estimated figures for annual realization, the various cost items, fixed investment and working capital. Indirect costs, fixed investment and working capital have been properly synthesized from several individually estimated items. Thus, the estimate is a very accurate one based on much information.

What does the estimate reveal when looking only at the mean values and the remarks, the way in which most cost estimates are usually presented?

Estimated profit is $729,950 per year; estimated return on investment, including working capital, is 13.35 percent. These exact figures would be found only if the actual values for every estimated item turned out to be the estimated mean values. The remarks show, however, that every individual estimated item may deviate more or less from the mean value.

WHAT CAN WE ACTUALLY EXPECT?

Management would certainly not expect to get exactly that profit and that return. They may think in terms of $720,000 to $740,000 per yr. profit and 13.2 to 13.5 percent return if they consider the estimate very accurate and reliable. Or they may arbitrarily draw some wider limits. But how wide should these limits be? Certainly there is no way to decide that, even when looking critically at the remarks.

Suppose the policy is to submit a project for approval only when the return is higher than 13 percent. According to the estimate this is an acceptable project. However, there is certainly a possibility that the actual figures will be lower. What is the probability that this would happen?

WANTED: GREATER ACCURACY

Other problems may also arise. Looking at the remarks, management may decide that the estimate is not sufficiently accurate. What items should be estimated more accurately? Should we ask for more thorough market research, for revision of the operating costs, or for additional design work to get more accurate figures on the investment?

All such questions can be answered in terms of probabilities.

In order to supply this required information the variances (squares of the standard deviations) have been calculated and shown in the table. The second column of variances includes only those components depending on fluctuations of the annual production and not on fluctuations of prices and quantities per ton of ammonia. (Details of these calculations are shown below.)

Standard deviation of the profit is found to be $79,810; standard deviation of the return is 1.45 percent. A table on the normal probability integral reveals immediately that the probability of the occurrence of a profit $700,000 or less is about 36 percent, which is relatively high. The probability that the return may be 13 percent or less is even higher, about 40 percent. There is an 18 percent probability that the return would be lower than 12 percent.

Should management want to be on the safe side they may ask what minimum values of profit and of return can be expected with 90 percent confidence. The answer is that there is one chance in ten that profit would be lower than $628,000 and return less than 11.5 percent.

Suppose management wants a more accurate estimate. The variances reveal that quantity of sales is the main source of inaccuracies, followed by uncertainties in estimated investment. As far as production costs are concerned the greatest inaccuracy is in the estimate of the labor, followed by the estimate of indirect costs. Hence, only the estimates of these particular items would need to be revised to materially improve over-all accuracy.

COMPARISON OF COMPETING PROCESSES

Now let us consider whether it is more advantageous to use coke as raw material instead of natural gas. Omitting all details, the final estimate based on the use of coke is shown in Table II. These figures show that costs are lower and profit higher than for natural gas; however, use of coke entails a somewhat higher investment than natural gas.

Which process is preferable? Is the difference in profits statistically significant or is it to a large extent due to inaccuracies of the estimates?

We should first investigate to what extent the apparent differences are caused by inaccuracies inherent in both estimates and to what extent by the change of raw material. We should eliminate the effect of fluctuations in the realization, which are the same in both cases.

Furthermore, we should consider only that part of the variance of the production costs which is independent of fluctuations in production. That component and the corresponding standard deviation for coke are shown in the two last columns of Table II for the costs, and as the variance of the realization is taken as zero, the same figures apply also to the profit.

The corresponding figure for natural gas is $(352.0 - 60.1)10^6 = 291.9 \times 10^6$ (see Table I), and the standard deviation of the costs and also of the profit at constant average production would be 17,085.

IS THE DIFFERENCE SIGNIFICANT?

We can now answer the question as to statistical difference between the two estimates of profit, using the t test:

$$t = \frac{830{,}000 - 729{,}950}{10^6\,(315 + 291.9)^{\frac{1}{2}}} = 4.1$$

The high value of t shows that the effect of inaccuracies would lead to lower profit in the coke estimate than in the gas process only about once in 50,000 cases. (See a table on the distribution of t in any comprehensive book on statistics.)

The standard deviation of the return is calculated for both coke and natural gas, based on the same selected component variances of the profits. The calculations are carried out in the same way as shown in the example for Table I. The applicable standard deviation for gas $\sigma_g = 0.307$ percent, and the applicable standard deviation for coke $\sigma_k = 0.316$ percent.

We can now decide whether the difference in the values of the return is or is not statistically significant, again using the t test:

$$t = \frac{13.75 - 13.35}{[(0.307)^2 + (0.316)^2]^{\frac{1}{2}}} = 0.91$$

This low value of t shows that there is about an 18 percent probability of getting a higher return with gas than with coke, a relatively high probability. Hence, it does not seem justified to spend the additional investment required in case of coke.

Statistical analysis indicates that at a fixed policy of a minimum 13 percent return the project should not be submitted for approval, as the risk of a return lower than 13 percent is too great. With coke instead of natural gas the profit will be higher, but not enough to justify the required additional investment.

The method can be better understood by following the details of the actual numerical calculations (see next page).

Details of Calculations for Statistical Analysis

Annual realization is the product of tons sold per yr. and selling price:

$\mu_R = 27,500$ tons per yr.
$\mu_R^2 = 756 \times 10^6$
$\sigma_R = (30,000 - 25,000)/5.2 = 963$
$\sigma_R^2 = 927,400$
$\mu_s = \$82$ per ton
$\mu_s^2 = 6,724$
$\sigma_s = (85 - 79)/5.2 = 1.155$
$\sigma_s^2 = 1.33$
$\mu_R = (27,500)\ (82) = \$2,255,000$ per yr.
$\mu_R^2 = 5.085 \times 10^{12}$

Using Eq. (5):

$$\sigma_R^2 = (756 \times 10^6)\ (1.33) + (6,724)\ (927,400) + (927,400)\ (1.33)$$
$$= (1,006 + 6,236 + 1.2) \times 10^6$$
$$= 7,242 \times 10^6$$

The last term (1.2×10^6) is negligible. The first term is the variance of annual realization caused by fluctuations of price; the second term is the variance caused by fluctuating sales.

ANNUAL PRODUCTION

The mean value μ_P is, of course, the same as for annual sales, or 27,500 tons per yr. The variance of the production, however, will be smaller than the variance of the annual sales σ_R^2 above. This is due to the leveling effect of product storage capacity of 4,560 tons. Accordingly:

$\sigma_R^2 = \sigma_P^2 + \sigma_K^2$
$\sigma_K^2 = [(4,560 - 0)/5.2]^2 = 770,000$
$\sigma_P^2 = \sigma_R^2 - \sigma_K^2$
$= 927,400 - 770,000$
$= 157,400$
$\sigma_P = 396$

Comparing σ_P with σ_R, we see that ups and downs in production need be less than half as great as the ups and downs in sales. Within these limits, therefore, in 99 percent of all cases shipments will not be delayed by reason of exhausted stocks or production restricted because of full storage.

INVESTMENT

Assume that *fixed investment* is estimated as the summation of 15 individual items, as shown in Table III. Then,

$\Sigma\mu = \mu_F = \$5,169,000$
$\Sigma\sigma^2 = \sigma_F^2 = 1,670 \times 10^6$
$\sigma_F = (1,670 \times 10^6)^{\frac{1}{2}} = 40,800$

Table III—Estimate of Fixed Investment

Limits	μ	σ	$\sigma^2 \times 10^6$
25,000– 28,000	26,500	578	0.33
45,000– 50,000	47,500	963	0.93
18,000– 22,000	20,000	770	0.59
150,000–170,000	160,000	3,850	14.82
220,000–260,000	240,000	7,700	59.30
700,000–800,000	750,000	19,300	372.42
650,000–750,000	700,000	19,300	372.42
320,000–380,000	350,000	11,530	132.94
410,000–450,000	430,000	7,700	59.30
820,000–900,000	860,000	15,380	236.54
50,000– 60,000	55,000	1,930	3.72
250,000–270,000	260,000	3,850	14.82
600,000–700,000	650,000	19,300	372.42
320,000–340,000	330,000	3,850	14.82
280,000–300,000	290,000	3,850	14.82

Assume also that *working capital* is $300,000 and that its variance $\sigma_W^2 = 24.3 \times 10^6$.

For total investment,

$\mu_I = 5,169,000 + 300,000$
$= \$5,469,000$
$\sigma_I^2 = (1,670 + 24.3) \times 10^6$
$= 1,694 \times 10^6$
$\sigma_I = 41,160$

ANNUAL COSTS

For purposes of clarity, these will be developed, not in the order of Table I, but in order of increasing complexity.

Procedure, in general, is to calculate the variance of unit cost per ton of ammonia for each item, σ_c. Then calculate the variance of the annual cost for each item, σ_C, by combining properly the unit cost with the annual production. In this way we can easily identify that portion of the variance of annual cost which depends upon fluctuations in production. We can also allow for cases in which some of the factors are correlated.

Annual cost of *supervision* is independent of all other factors. Variance is calculated simply as:

$\sigma_C = (60,000 - 50,000)/5.2 = 1,930$
$\sigma_C^2 = 3.7 \times 10^6$

Depreciation is an exact function of fixed investment and is likewise independent of all other factors:

$\sigma_C = 0.05\ \sigma_F = 2,040$
$\sigma_C^2 = 4.2 \times 10^6$

Annual cost of *labor* must allow for two uncertainties—an uncertainty in the cost per ton of production and another uncertainty in the tons produced per year. Variance of annual cost is obtained as the variance of the product of cost per ton and tons per year, as follows:

$\mu_c = \$11$ per ton
$\sigma_c = (12 - 10)/5.2 = 0.385$
$\sigma_c^2 = 0.148$

Using Eq. (5) and neglecting the last term:

$$\sigma_C^2 = \mu_P^2 \sigma_c^2 + \mu_c^2 \sigma_P^2$$
$$= (27,500)^2\ (0.148) + (11)^2\ (157,400)$$
$$= (112 \times 10^6) + (19 \times 10^6)$$
$$= 131 \times 10^6$$

Of the two terms whose total is the variance of annual labor cost, the first is due to fluctuations in cost per ton and the second to fluctuations in production rate. The second term is extracted from the total and shown separately in Table I.

Annual costs of *steam, water, catalysts* and *supplies* are calculated in exactly the same manner. Although *repairs* and *other indirect costs* are estimated on an annual basis, they are assumed to vary with production. Their variances are calculated similarly, first expressing μ_c in dollars per ton by dividing μ_P into μ_C.

Annual cost of *natural gas* is complicated by several factors. Here we have uncertainties in unit consumption and unit price, in addition to production fluctuations. Further, the unit price is correlated with annual consumption.

We first obtain the variance of the unit cost of gas per ton of ammonia, observing that price of gas and consumption per ton are uncorrelated:

$\mu_q = 26$ M cu. ft. per ton
$\sigma_q = (28 - 24)/5.2 = 0.77$
$\mu_p = \$0.08$ per M cu. ft.
$\sigma_p = (0.085 - 0.075)/5.2 = 1.93 \times 10^{-3}$
$\sigma_c^2 = (26)^2\ (1.93 \times 10^{-3})^2 + (0.08)^2\ (0.77)^2$
$= 6.3 \times 10^{-3}$
$\mu_c = (26)\ (0.08) = 2.08$
$\mu_C = (27,500)\ (2.08) = \$57,200$ per yr.

There is a perfect negative correlation between gas price and quantity used per year, requiring that we use Eq. (8):

$$\sigma_C^2 = \mu_P^2 \sigma_c^2 + \mu_c^2 \sigma_P^2 - 2\ \mu_P\ \mu_c \sigma_P \sigma_c$$

The correlation, however, is not between annual production P and cost of gas per ton c, but between annual production P and price of gas per M cu. ft. p. This requires that we rewrite our equation in terms of P and p.

Remembering that

$$\mu_c = \mu_q\ \mu_p$$

and

$$\sigma_c^2 = \mu_q^2 \sigma_p^2 + \mu_p^2 \sigma_q^2$$

the first two terms on the right become:

$$\mu_P^2 \mu_q^2 \sigma_p^2 + \mu_P^2 \mu_p^2 \sigma_q^2 + \mu_q^2 \mu_p^2 \sigma_P^2$$

Inasmuch as r_{qp} and $r_{Pq} = 0$ and $r_{Pp} = -1$, the correlation term takes into account only those terms which contain σ_P and σ_p, becoming:

$$-2\ [(\mu_P^2 \mu_q^2 \sigma_p^2)\ (\mu_q^2 \mu_p^2 \sigma_P^2)]^{\frac{1}{2}}$$
$$= -2\ \mu_P\ \mu_q^2\ \mu_p\ \sigma_p\ \sigma_P$$

Solving numerically, we get:

$$\sigma_C^2 = (1.91 + 2.87 + 0.08 - 2.27) \times 10^6$$
$$= 3.2 \times 10^6$$

Only the second term is independent of fluctuations of annual production or correlated price. The component of variance depending on such variations is:

$(3.2 - 2.9) \times 10^6 = 0.3 \times 10^6$

For *electric power*, we first compute the variance over the wider set of limits, neglecting the correlation between power and gas consumption which permits use of the narrower set of limits:

$\mu_q = 850$ kwh. per ton
$\sigma_q = (900-800)/5.2 = 19.3$
$\mu_p = 0.007$
$\sigma_p = 0$
$\sigma_c^2 = (850)^2\,(0)^2 + (0.007)^2\,(19.3)^2$
$= 1.82 \times 10^{-2}$
$\mu_c = (850)\,(0.007) = 5.95$
$\mu_C = (27,500)\,(5.95) = \$163,500$ per yr.
$\sigma_C^2 = (27,500)^2\,(1.82 \times 10^{-2}) +$
$(5.95)^2\,(157,400)$
$= (13.9 \times 10^6) + (5.6 \times 10^6)$
$= 19.4 \times 10^6$

Here, again, the second term is dependent on the variance of the production.

There is a correlation between the consumption of electric power and of gas—higher consumption of power per ton of ammonia is expected when the consumption of gas per ton of ammonia is in the upper part of its range. This is a case of imperfect correlation, so we find r according to Eq. (1).

The standard deviation of power per ton of ammonia at mean gas consumption per ton is:

$\sigma_q' = (870 - 830)/5.2 = 7.7$

$$r = \frac{[(19.3)^2 - (7.7)^2]^{\frac{1}{2}}}{19.3} = 0.92$$

Since the computation of over-all costs involves addition, the correlation term $2r\,\sigma_a\,\sigma_b$ is taken from Eq. (2). For electric power σ_a can be taken equal to $\sigma_c = (19.4 \times 10^6)^{\frac{1}{2}} = 4,400$.

However, σ_b for gas must be taken at a value which does not include the effect of price variations, as price of gas does not enter this correlation. Looking at the calculation of σ_c^2 for gas it is apparent that only the second and third terms need be considered here.

Therefore,

$\sigma_b = [(2.87 + 0.68) \times 10^6]^{\frac{1}{2}} = 1,890$

Hence the correlation term

$2r\,\sigma_a\,\sigma_b = (2)\,(0.92)\,(4,400)\,(1,890)$
$= 15.3 \times 10^6$

PROFIT

Profit is the difference between annual realization and annual costs. Hence we use Eq. (4), where the standard deviations used in the correlating term are the square roots of those components of the variances which depend on fluctuations of production:

$\sigma_E^2 = \sigma_R^2 + \sigma_C^2 - 2\,\sigma_{R(P)}\,\sigma_{C(P)}$
$= (7,242 \times 10^6) + (352 \times 10^6) -$
$(2)\,(6,236 \times 60.1)\,(10^6)$
$= 6,370 \times 10^6$
$\sigma_E = 79,810$

Standard deviation of the return is found most conveniently by using logarithmic scales when the investment is relatively large, as is the case here. (Otherwise, calculate $1/I$ and $\sigma_{1/I}$ and use the formula for products on numerical scales.)

First we must convert the standard deviations of profit and of investment over to logarithmic scales:

$$\sigma_{\log E} = \log \frac{\mu_E + \sigma_E}{\mu_E}$$

$$= \log \frac{729,950 + 79,810}{729,950}$$

$= 0.0448$

$$\sigma_{\log I} = \log \frac{5,469,000 + 41,160}{5,469,000}$$

$= 0.0031$

Now using Eq. (7):

$\sigma^2_{\log e} = (0.0448)^2 + (0.0031)^2$
$= 20.17 \times 10^{-4}$
$\sigma_{\log e} = 0.0449$
$\sigma_z = (\text{antilog } 0.0449)\,(\mu_e) - \mu_e$
$\mu_z = 13.35\%$
$\sigma_e = (1.109)\,(13.35) - 13.35$
$= 1.45$

Use of numerical scales leads to essentially the same result.

CENTRIFUGALS

Continued from page 142

MAINTENANCE COSTS

Maintenance costs for light to moderately severe service are given in Table V, as annual percentages of the purchase prices of the machines. Despite the high speeds of most centrifugal machines, maintenance costs are usually fairly small.

In all types of machines, bearings and spindles are most subject to wear. Cloth filter media in basket centrifugals require frequent replacement, and unloader knives, particularly in automatic batch machines, are likely to suffer from erosion. In scroll conveyor centrifugals the periphery of the helical conveyor wears away as it moves settled solids out of the pond of liquid. In very severe service with highly corrosive fluids, of course, the cost of maintenance may be several times the indicated values.

Table V—Typical Maintenance Costs

Type	Annual Maintenance Cost, Percent of Purchase Price
High-Speed	
Tubular	5-10
Disk	5-10
3-Way separator	10-25
Batch	
Top-suspended	5-10*
Base-bearing	5-10
Link-suspended	5-10
Batch Automatic	
Sharples Super-D-Hydrator	3-6
Baker Perkins automatic	3-5†
Continuous Conveyor	
Reciprocating	3-6
Scroll	5-8

*Up to 20 percent for very corrosive materials.
†Does not include filter media.

OPERATING LABOR

Requirements for direct operating labor are indicated in Table VI. With continuous machines one operator can run 5 to 20 machines without difficulty, and with no manual labor other than occasionally adjusting a valve.

Table VI—Labor Requirements

Type	Direct Operating Labor, Men Per Machine
High-Speed	
Tubular	0.05-0.25*
Disk	0.05-0.20*
3-Way separator	0.05-0.15
Batch	
Top-suspended	0.33-0.5
Base-bearing	0.5-1.0
Link-suspended	0.5-1.0
Batch automatic	0.2
Continuous conveyor	0.2

*May reach one man per machine when very frequent cleaning is necessary.

Sometimes with high-speed centrifugals, and nearly always with batch centrifugals, considerable manual effort is needed to clean the bowl or load and discharge the basket. Labor requirements are particularly high with base-bearing and link-suspended centrifugals in which the basket contents are discharged by hand through the top of the machine.

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Silicothermic Magnesium Comes Back

Although presently not competitive with electrolytic magnesium, silicothermic magnesium is back in the fold to meet the demands for production now. Process is being improved: continuous operation is under study.

ELLIOT SCHRIER

The silicothermic or ferrosilicon process for the production of magnesium is similar in at least one respect to fire insurance: expensive if never needed but cheap at almost any price when required.

When a nation is rearming consideration of process economics must necessarily come after demands for production "now." Under such conditions processes that could never compete in a peacetime economy are called into service. Silicothermic production of magnesium is a classic example of such a process.

During World War II the government financed construction of six silicothermic plants with a total capacity of 138 million lb. per yr. Few of the plants reached their rated capacities, however, and in all cases the magnesium crystals cost over 18c. per lb., averaging 27.39. (Magnesium ingots produced electrolytically cost as little as 11.51, averaged 18.24c. per lb.) But the plants did their job. By mid-1944 the crucial need for magnesium had been met; our stockpile was high enough to permit cut-backs in production. The silicothermic plants were mothballed first, others were placed in stand-by condition or dismantled soon afterwards, and by Dec., 1944 only 16 percent of our total Mg. capacity was in production.

No significant change occurred from late 1944 until the Korean "police action" and ensuing rearmament program increased magnesium requirements 400 percent in less than a year. Active and stand-by electrolytic facilities were not sufficient to meet the added demand, nor could they be expanded quickly enough. So once again the government called upon its fire insurance; in late 1950 and early 1951 GSA reactivated four silicothermic magnesium plants, including one built and operated during World War II by Permanente Metals Corp., forerunner of Kaiser Aluminum & Chemical Corp.

ELLIOT SCHRIER is West Coast Editor of Chemical Engineering located in San Francisco. His report here represents close to six months of effort including that required for government clearances.

When Permanente received its government contract for construction and operation of a 20 million lb. per yr. magnesium plant at Manteca, Calif., in March, 1942, the Kaiser organization could claim no experience in magnesium production. Yet a $6,142,000 17-building plant was erected, and less than five months after signing the contract Permanente poured its first magnesium.

The speed with which pasture land can be converted to magnesium production using the silicothermic process is one of the two features of the process that make it attractive during periods of critical demand. The other feature is the fact that it requires no critical equipment or material. Calcined dolomite and ferrosilicon, basic raw materials of the process, are seldom in short supply, even during wartime, and the process adds no burden to already over-strained electric power systems.

In the two years the Manteca plant was in operation during World War II it produced 25,419,205 lb. of magnesium crystals. With a 12 percent loss of weight from crystal to pig, this represented 22,368,900 lb. of magnesium ingots. According to GSA figures, the crystals cost an average of 27.82c. per lb., not including amortization of the $6,142,000 spent on the facilities proper.

On Jan. 18, 1951, Kaiser Magnesium Co., wholly-owned subsidiary of Kaiser Aluminum & Chemical Corp., was formed to reactivate and operate the Manteca plant for GSA. Work started Feb. 4, ingot production June 6. Rehabilitation, involving no expansion of designed capacity, cost about $1¼ million. Kaiser also spent $1,700,000 for a third rotary kiln at its Natividad, Calif. dolomite plant, increasing capacity 50 percent, and for rehabilitation of three electric arc furnaces at its Permanente, Calif. ferrosilicon plant.

THE PROCESS

Heart of the silicothermic process is a 10½ ft. by 10 in. retort. At Manteca there are 1,024 retorts housed in two furnace buildings, each building containing two rows of furnaces, 16 furnaces to a row, with 16 retorts in each furnace. The retorts are cast in one piece from a stainless steel alloy containing 15 percent Ni and 28 percent Cr. Average life of a retort is 250 days, and on the average each retort is charged 2.4 times per day—each charge producing 28-35 lb. of magnesium crystals. The retorts cost about $925 installed, including $700 for the retort, $125 for labor and $100 for a sleeve jacket that has to be welded on. This jacket circulates cooling water around the condensing end of the retort.

The retort charge consists of 200-250 lb. of pellets compressed to a density of 72 lb. per cu. ft. These pellets, 4.5 parts calcined dolomite ground to 80 percent −100 mesh, 1 part FeSi (75 percent Si) ground to 70 percent −200 mesh and 0.1375 part (2.5 percent by weight) fluorspar, are bagged in 40-50 lb. 2 ply paper bags of 1/40 and 1/50 kraft ply. Pellets are handled bagged rather than loose for two reasons: to prevent decrepitation and to permit complete filling of the retorts. Loose pellets crumble quickly in storage bins (even bagged pellets cannot be stored for any great length of time) and seek their own level in the retort before it can be filled.

Fluorspar, acting as a catalyst, increases yield and appears to inhibit afterburning of the magnesium by a denser deposit of metal.

After the retort is charged with five bags of pellets, a metal heat dam is placed 2 ft. from the open end. The empty 1½ ft. sleeve within which the magnesium will condense is then inserted and plugged with a two layer, eyed metal disk. This disk serves a twofold purpose: it provides a means of withdrawing the sleeve after the reaction is completed and collects any sodium or potassium that might be present in the reaction vapors. This last function is important, for if the concentration of sodium and potassium in the magnesium crystals exceeds 0.10 percent the hot "muff" will ignite spontaneously when the retort is opened. Taking advantage of the alkalis' higher vapor pressures, the sodium collector separates them from the magnesium while they are still in the vapor state.

The process proper takes 9 hr. and 45 min., is separated into three phases: burn-off, low vac and high vac times. The burn-off period, lasting 15 min. drives off most of the combined water before the retort is closed and sealed. During the first 30 min. after sealing the pressure is reduced to 26 in. of Hg; then for 9 hr. it is reduced to 100-150 microns. Under this vacuum and at a temperature of 2140 F. the following reaction takes place:

$$2(MgO.CaO) + 1/6FeSi_2 \rightarrow 2Mg + (CaO)_2SiO_2 + 1/6Fe$$

Water is circulated through the sleeve jacket at a rate of 1 gpm., entering at 78 and leaving at 88 deg. F. This reduces the temperature of the sleeve to 450 deg. F., allowing the vaporized magnesium to condense in a crystalline muff. About 80 cu. ft. of gas with a Btu. content of 1,000 per cu. ft. are required to produce 1 lb. of magnesium crystals. The Manteca plant operates under an interruptible natural gas contract, and when such supply is curtailed operations continue at full capacity on stand-by supplies of propane.

Magnesium muffs, removed from the sleeves by a hydraulic press, are carted to the foundry and remelted a ton at a time in cast steel melting pots. Sufficient quantities of 40 percent reclaimed-60 percent fresh Dow 230 flux are added to remove Ca_2Si0_4, MgO and Mg_3N_2 through combination. Fluxing also reduces certain of the heavy metal impurities, principally iron. Largest and most objectionable impurity, however, is MgO.

Magnesium thus cast is Grade B, meets Specification P-71 calling for at least 99.8 percent magnesium, less than 0.02 percent copper, 0.005 percent iron and 0.001 percent nickel.

Sludge from the foundry melting pots is run through a dross recovery unit where it is crushed, rolled and screened. Flux and magnesium metal are recovered from this operation.

Residue resulting from the retorting operation consists mainly of dicalcium silicate and iron oxide, with some unreacted ferrosilicon and calcined dolomite. This residue has a limited value as a soil conditioner, and it has been considered as an insulating material, as a hydraulic cement, and for sand-lime bricks. At the present time these applications have not proved economically feasible, however, and residue continues to accumulate at the rate of approximately 62,000 tons per year.

PROCESS IMPROVEMENTS

In an effort to lengthen the period in which the silicothermic process can compete, many cost cutting improvements have been or are being developed. Some of these, however, are of a minor nature, since the basic simplicity of the process lavs little room for design improvement.

Removing magnesium from sleeves. Gaseous magnesium condenses on these sleeves.

Firm pellets, free from fines, are essential to efficient operation of the process. No adequate binder has been found, and power requirements and maintenance costs limit the density that can be obtained with briquetting presses. Predensification has improved pellet characteristics, reduced decrepitation and improved retort yields, but Kaiser hopes that still better pellets can be made.

Another improvement involves recovery and purification of vacuum pump oil.

A major effort to cut costs and improve yields is concentrated on the retorts themselves. The higher the vacuum the higher the yield, but air, diffusing through microcracks in the retorts, and line leaks set an upper limit to obtainable vacuums. Sounder casting, or fabrication rather than casting, would reduce the number of such microcracks and allow higher vacuums—and thus higher yields—to be obtained.

In addition to allowing diffusion of air, microcracks also provide weak spots that eventually ruin the retort. Retorts, operating under such high vacuums and temperatures, occasionally collapse. When this occurs they are blown up again with air at 100 lb. pressure. The cycle can be repeated many times, but eventually a hole is blown through the retort wall—usually at a point already weakened by microcracks. In an effort to avoid discarding an entire $700 retort when only a small part has been damaged, Kaiser will soon test sectional retorts. If they prove practical, sound sections salvaged from used retorts will be welded together, markedly reducing retort repair and replacement costs—which represented about 15 percent of the final magnesium cost during World War II.

With various labor-saving improvements Kaiser has been able to produce as much magnesium with 600 men on a 5-day week as was done during the war with 804 men on a 6-day week, reducing labor costs appreciably from the wartime average of 17.1 percent. The union does not object to this effort to reduce the working force—indeed, it even cooperates for it realizes that the more economically the plant can operate the less marginal may be the times in which it can survive.

Perhaps the most important improvement of all is taking place in the foundry. At present molten magnesium is cast into ingots by hand. A new method, almost completely installed, calls for tilting furnaces to pour the melt into a dumping ladle suspended from a monorail. The ladle will, in turn, charge two continuous ingot casting machines.

This switch from batch to continuous operation might foreshadow the one development that could save the process from another mothballing. U. S. Bureau of Mines researchers at Albany, Ore. are working on a continuous silicothermic process for production of magnesium. If they are successful the process might be able to compete in "normal" times, for it is mainly the batch-wise nature of the present method that makes its product so expensive.

HOW TO . . .

Work Out a Maintenance Budget

REMEMBER the five basic steps to good maintenance.
ESTABLISH a fair basis for your maintenance budget.
CONTROL expenditures and avoid large deviations.
MEASURE performance against a recognized standard.

JACKSON D. LEONARD

"What is a maintenance budget and what is its proper place in a good maintenance program?"

A maintenance budget is simply a target for the maintenance organization to shoot at, and achieve if possible. However, the second part of our question is more difficult to answer. In many companies, the maintenance budget is nothing more than a figure dictated by management, and any deviation from it brings down all kinds of storms. This type of so-called budget is useless—a mockery of the word.

The intelligent budget can be met if the maintenance organization has the proper backing for its job. Proper backing should take in attitude, an adequate work order system, an adequate maintenance organization, a planned maintenance system, and finally, when the first four factors have been provided, a budgetary control and reporting system.

FIVE BASIC STEPS

Attitude—First, management must realize that maintenance performance can be likened to a production line. If maintenance gets better tools, adequate organization, and technological help to achieve better methods, it too, can achieve "increased production" in the form of lower costs and better performance. Once management is sold on this, maintenance supervision itself must have an attitude receptive to new programs.

Unfortunately, the attitude of some maintenance supervision is as much of a stumbling block to progress, as management's backward attitude. Some plant engineers when informed that management is willing to increase maintenance spending can think of only one way to spend the additional money—more craftsmen for the hardest pressed areas of his plant.

Try to get this engineer to spend for a good work order system, an adequate organization, or a planned maintenance system. They haven't seen how those things work out, and they don't care to try anything new. I place attitude at the top of the list in working toward good maintenance.

Adequate Work Order System—A good work order system can accomplish so many constructive things: Control of the work to be performed, job costs, equipment costs, and information suitable for many types of analysis and control. Since it costs little, it is surprising that few plants have a good work order system.

Adequate Organization — A line foreman, whether engaged in production or maintenance, cannot properly supervise a crew of more than 10 men, yet, in thousands of plants, this is observed only in the case of production supervision. Maintenance foremen usually have to handle 15 to 25 men per crew. A breakdown of these oversize crews into the proper size units will result in an amazing increase in efficiency.

Does the increased cost of the added supervision really pay for itself? Yes, several times over. A crew of 25 men under one foreman, if broken into two crews supervised by two foremen can increase its productivity by 10 percent or man hours equivalent to 25x10 percent x 40, or 100 hours per week gain in craft hours, at an increased cost of 40 supervisory hours.

Not only is there a direct increase in productivity, but additional supervisory know-how is available for training, development of better methods and propagation of company policies.

A good technically trained man can save at least 10 times his annual salary by a series of improvements upon the process or operation. Many companies exploit this policy to the fullest in its production department, but the companies are rare who use this principle in their maintenance department.

Planned Maintenance—Let us not be deceived by a name. Planned maintenance is nothing more than a small staff group that plans and schedules the work of the maintenance department to cut down on waste time.

In some plants it is called "The Planning Section," or "The Scheduling Group," or "The Control Group," but, excepting side duties, the only difference is the name. Naturally, such a staff group is in an ideal position to handle equipment cost records, and cost analyses of all types. It can also do a creditable job preparing the maintenance budget, and controlling and reporting performance on the budget.

The formation of such a group is economically sound. Increased effectiveness pays for the cost of the added "control people" 2 or 3 times over, sometimes 10 times over.

Let us now examine how a good budget can be established.

BASIS FOR A BUDGET

Cost Records—Maintenance cost records, a part of a good work order system, can be used to determine the expected cost of maintaining every piece of equipment, every building, utility and office on the plant.

Production-Maintenance—One approach is a correlation of maintenance man hours against production in each department of the plant. The budget can then be made to take care of fluctuations in production rate. But it must assume the cost of materials, unless departmental records on material costs are maintained.

This approach is not as accurate, and when the budget is underrun or overrun, it will be difficult to determine why. Even with weekly reports, it will sometimes be hard to deter-

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mine the reasons for deviations, especially during a period of high activity.

Electricity - Maintenance—Another basis commonly used to establish the maintenance budget is electric power consumption figures. Here again, some arbitrary ratio between power consumed and cost of maintenance must be assumed, derived or measured.

The difficulty of such indirect measures is that local factors are often ignored in such a budget. For example, two silk spinning plants with identical processing machinery had identical maintenance budgets established based on power consumption records. The one plant was located in good masonry buildings of sound design, while the other plant was located in old buildings of part wooden, part masonry, part steel frame construction.

Maintenance in the old plant actually cost over 50 percent more than the newer plant. The older buildings required more repairs, and multiplied rigging problems in handling machine repairs. It was responsible for more repairs due to bad vibration conditions and more difficult maintenance due to poor arrangement, cramped space, and insufficient access space.

Past Performance Records—After a budget has been established for several years, past performance figures will be the best guide for succeeding budgets. Such figures should show: labor man hours, materials costs, and production figures by operation, or by department.

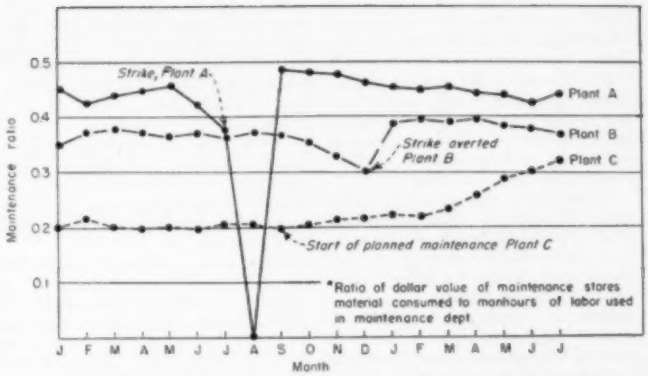
With such information, it should be feasible to prepare budgets, with an accuracy of plus or minus 5 percent, for a year in advance. Index figures can be used to forecast labor and material cost increases, and production forecasts can be used to take care of fluctuations needed to correlate with productions changes.

CONTROL OF BUDGET

Actually, the real problems in budgetary control are not in the establishing of the budget. They are in the control of maintenance expenditures to stay within the budget, and avoid large deviations.

Fluctuating Production—Numerous companies are subjected to rapid production upsets, and are stuck when a budget is based on steady production. I have found only one sensible approach to such a problem.

Let us assume that the proposed maintenance budget for such plant totals an expenditure of $100,000, exclusive of supervision and overhead costs. Knowing serious production fluctuations may occur during the year, a labor force should be set up which will use not more than 50 percent, or $50,000 of the proposed budget. Material purchases, and outside contract work can then be scheduled or purchased to keep within the budget figure.


Strike, Plant A
Plant A
Plant B
Strike averted Plant B
Plant C
Start of planned maintenance Plant C
*Ratio of dollar value of maintenance stores material consumed to manhours of labor used in maintenance dept
Maintenance ratio
0.5
0.4
0.3
0.2
0.1
J F M A M J J A S O N D J F M A M J J
Month

A good measure of performance, the three ratios are fairly steady in normal times. Plant C, the oldest plant, upped its ratio when it put in planned maintenance.

Thus, if production falls 25 percent, reducing the maintenance budget to $75,000, the labor force can be kept intact and will consume $50,000 of the total and leave only $25,000 for the purchase of needed materials, or outside contractor services. Conversely, if the production rate goes up 25 percent making $125,000 available for maintenance, extra repair material, or added outside contractor services can be purchased to use the difference.

One of the minor problems encountered: It is often difficult to obtain rapid deliveries of materials and services to use up monthly dollar surpluses. This is remedied by precharging for material on order but not yet billed to the plant. Or, charging out a fixed amount monthly against costs with quarterly adjustments made from actual billings.

At several plants, it was found that in those months where production fell off, the full maintenance crew could be profitably used to tear down and overhaul major pieces of equipment not available for overhaul except during low production. And such overhaul work required high labor expenditure, but relatively small material consumption.

Also, during these periods of low production, accumulated materials, paid for out of preceding months' budgets, could be used to rebuild and replace machines, buildings or facilities that had been planned in advance.

Unavailable Cost Figures—As a rule, the maintenance organization cannot get accurate up to date figures on expenditures. But the material clerk in a planned maintenance system should provide up-to-the-minute material cost figures. This man not only orders all maintenance material and sees that it is in the plant before the time it is needed, but he also maintains a daily cost record.

In lieu of such service, the accounting division should make up weekly figures on expenditures and commitments. When it learns the maintenance department is chiefly interested in round numbers, and not exact down-to-the-penny figures, a cheap and quick procedure is possible.

In a number of plants where planned maintenance systems provided the figures, the material costs, charged out by the accounting division, disagreed with the figures accumulated by the maintenance department by as much as 40 percent. In one case investigations revealed operating supervisors were using repair codes to buy their supplies.

In other cases, accounting practices were so careless that all kinds of charges were made to the maintenance material account simply because no one had ever bothered to check it before. Without a careful check, correct material cost never would be found or picked up.

No Shutdowns For Repairs—The policy of no shutdowns may result in a plant becoming so run down that emergency equipment breakdowns take a serious toll of production. In one case, management's shortsighted policy caused maintenance expenditures to appear fairly normal during the first portion of an eight year

period. But actually expenditures were chiefly for an emergency breakdown. Thus higher than they should have been.

But during the last portion of that period, the maintenance budget cost looked like a reproduction of the national debt curve. And considerable production was stopped to permit overhauling and rebuilding.

Maintenance-Construction Confusion—Maintenance departments are often required to handle all construction work in the plant. In such plants, cost figures for labor, material, supervision, stores, contractor services, and supplies are difficult to separate and even more difficult to control. Management must be brought to realize that maintenance and construction require handling by separate organizations having different skills and knowledge. Likewise good maintenance budgeting performance will only be achieved when such a split is made.

Catch-All Department—The maintenance department frequently serves as the plant "catch-all" and performs types of services that cannot be considered maintenance by any stretch of the imagination. For example, janitor service, messenger service, unloading of raw materials, operation of intraplant transportation systems, providing many types of operating service items.

Many others are oftentimes wished off on the maintenance department. After a time these items have a nasty habit of appearing as maintenance cost items. The most abused of these factors is the provision of operating service items. For example, in most plants an operating supervisor can write a repair order and have the maintenance department build all types of small operating convenience items such as portable steps, tarpaulins over temporary operations, extension handles, bins, scoops, buggies and carts.

Such items should never appear as maintenance costs. Instead, a cost account called "service to operations" or some similar title should be set up. These items should be charged against such an account. If minor expenditures had to bear the searching light of management scrutiny on their own merits, rather than hiding under the cloak of maintenance repairs, 90 percent of them would never be done.

Is the Budget Fair?—Perhaps, one of the worst problems to deal with is the plant where inquiring management suspects a reasonable maintenance budget is too high. Then they fear competitors are doing the maintenance job cheaper, leaving them behind competitively. Here the problem is to measure maintenance performance against some recognized standard, and show that the performance is good, fair or bad.

MEASURING PERFORMANCE

Time Study—For direct measurement, management can call on a team of experts, usually composed of an engineer, a time study man trained in mechanical procedures, and an industrial engineer.

This team usually takes a typical section of a plant, and studies it in detail. It makes a brief check on over-all plant scheduling, material control and handling, cost accounting, etc. At the end of a month, it usually makes a report suggesting improvements and also rating the work being performed compared to other plants and locations.

This perhaps is the only completely reliable method of determining performance. But the cost will run from $3,000 to $6,000 depending upon the complexity of the plant, and the thoroughness of the study desired.

Percent of Capitalization—Perhaps the most widely used indirect method of measurement is the cost of maintenance expressed as a percentage of capitalization. Some arbitrary figure, anywhere from 2.5 to 10.0 percent of capitalization, is used as the performance standard.

This method has its drawbacks: First, during the last 10 years, maintenance costs have become a greater and greater percentage of the fixed capital. As much as 7 percent difference can exist in the same industry between plants built prior to 1940, and new plants built after 1948.

When an attempt is made to apply a correction factor, all sorts of difficulties arise—incomplete records, poor accounting, changed accounting practices, and differences of opinion as to which of the available set of indexes and factors should be used. Then too, many executives suspect that corrected figures are nothing more than loading the dice in favor of the answer wanted.

Thus, this basis, commonly used though it may be, is subject to many faults. It is open to criticism as to accuracy and dependability, but once established in a given plant, it will serve as at least an indication of the trend of the performance and can be useful as such.

Repair Labor/Operating Labor—Another commonly used method of measurement, is a ratio of man hours of repair labor against man hours of operating labor. Here again, the faults are many: Manufacturing processes, production rate, labor requirements, and materials are constantly changing. They contribute substantially to changes in the operating labor hours for the plant, or per unit of production.

In a certain plant, built in the last three years, designers had gone all out to provide automatic devices, controls and instruments to cut labor costs. They reduced it to a point where two men per shift were able to operate a unit costing several millions of dollars.

However, to keep all these instruments and automatic controls functioning properly required the services of six highly trained and highly skilled instrument mechanics. A direct comparison with an older unit showed maintenance cost was over twice as high. So this method of measurement can only be regarded as an indication of performance trend, and not an absolute measure.

Stores Material/Repair Labor—Identical objections can be raised against almost any indirect method. However, several years ago, during a study made on a large group of plants, one ratio seemed to give a fairly good measure.

This ratio was the dollar value of the maintenance stores material consumed, to the man hours of labor used in the maintenance department. It assumes, for example, that a group of pipefitters doing a normal month's repair work in any plant having the same type of piping will consume about the same amount of material in the normal course of making their repairs.

This same theory applies to any group of craftsmen. The only factor that needs be stabilized in such a measurement is the standardization of repair material carried in stores. The only figures available at present which show this ratio, are from a group of chemical plants.

In a group of modern chemical plants having excellent shop facilities, good tools, central store distribution points, and well designed equipment and buildings, the figures revealed a material consumption of $0.50 to $0.60 per man hour of repair labor, or stated another way: Facilities, design, supervision, and other factors were so good, that one man hour of labor was all that was required to get $0.60 worth of repair material into service.

In a group of older plants, having older buildings and equipment, but with good shop facilities and tools, good material distribution, and good planning and scheduling, the ratio ran between $0.35 to $0.45.

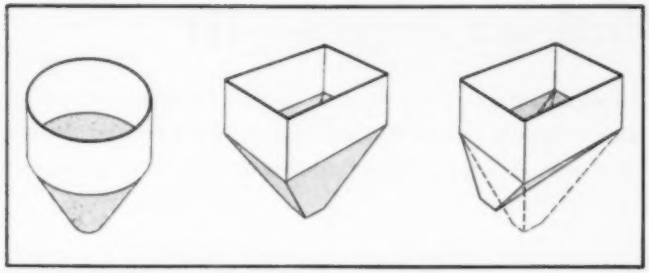


Fig. 1—Common shapes for hoppers. Drawing at right shows a hopper with one straight side (solid lines) and a hopper with two straight sides (dotted lines).

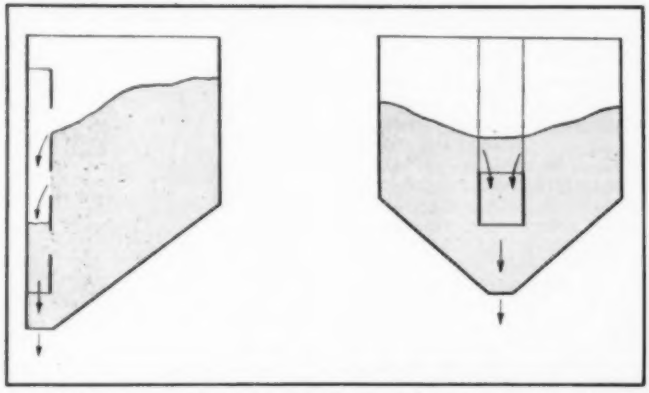


Fig. 2—Many attempts have been made to facilitate flow of material from hoppers. Those shown here are based on misconception of the function of straight sides.

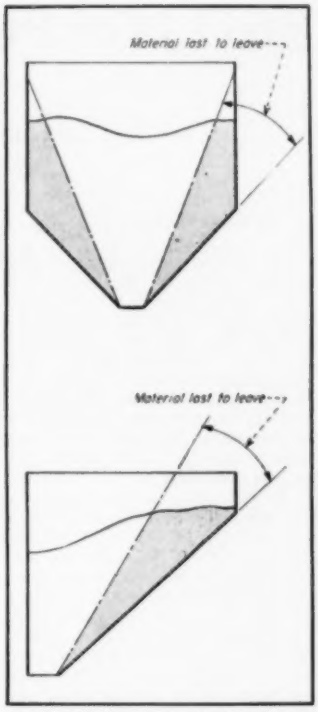


Fig. 3—Subsidence of material with flow through outlet for two different shapes.

New Ideas About Hoppers

Contrary to common belief, straight sides do not help flow of materials from hoppers—and you can save some storage capacity by not incorporating them in your design.

CHESMAN A. LEE

Considerable difference of opinion and confusion exists on the part of designers and users of steel hoppers. The opinion expressed in this article offers economy of design and a maximum of trouble-free operation. While somewhat radical, it is not inconsistent with the sound theoretical work done many years ago.[1,2]

A hopper is a bin with bottom plates so sloped that material will slide towards the outlet. When we speak of a straight side, we mean one bottom plate is vertical and merely a continuation of one of the sides of a rectangular hopper. That side is in line with the gate.

C. A. LEE *is a chemical engineer with Darling & Co., has had over thirty years' experience with materials handling and storage.*

COMMON IDEAS ABOUT HOPPERS

You may have heard the following opinions expressed:

1. Don't make the slopes too steep as then the material will wedge, and pack, in the narrow angle. Make the slope flat enough so that arch action in the body of material will support the weight and keep pressure from building up on the material beneath it.

2. To avoid segregation, make the slopes steep so that material on sloping sides will be pushed out uniformly by the material above.

3. Provide at least one straight side as material can't arch against a vertical surface.

None of the above has a sound theoretical basis. Take this third common idea about hoppers, for example. Having at least one straight side is, at first thought, a very desirable and sound feature even though some storage capacity is sacrificed. Thought behind this is that arching is inconsequential against a vertical surface. But if this were correct, the Janssen analysis of grain pressures in deep bins would fall of its own weight. Again if this idea were correct, an easy way to design a hopper would be to use any reasonable shape and install a vertical plate

(Continued on p. 173)

Stacks for Pollution Control—III

Last of three articles on stack heights for effective control of pollution by dispersion into the atmosphere. First article, general principles; second, plume height; third, dispersion of particles.

S. R. STEINBOCK

The practice of installing separating devices such as electrostatic precipitators or other means of removal of suspended particles from chimney discharges has long been accepted in industry.[5, 6, 9] Absence of such remedial measures has often led to problems in public relations. Eventually, industry has often been compelled to do something to remove this most objectionable type of air pollutant, or at least to decrease it.

An interesting but hardly a unique example might be mentioned. During the war a large chemical plant was erected on the U. S.-Canadian border. The power house (then without precipitators) emitted over 100 tons of fly-ash per day. The surrounding countryside was virtually covered with the ash and property in a very prosperous residential area became almost worthless. Then, installation of precipitators reduced fly-ash emission to less than 20 tons per day. This was a marked improvement in the situation.

Coal-fired power stations, however, are not the only sources, or even the most important sources of pollution of this type. Many chemical and other process plants have tremendous problems in controlling the deposition of fine dusts which they must discard. Foundries, cement and fertilizer plants are typical of this group.

The most serious limitation on the use of the customary industrial precipitating devices lies in their selective action. In the case of cyclones, for instance, only the larger diameter particles are effectively removed. These particles in any event would have settled out close to the source of emission, whereas the smaller particles not removed by the equipment still present a pollution problem. But, so long as economical means are not available for total or nearly total elimination of solid particles from factory chimneys, an attempt must be made to insure particle dissipation over as large an area as possible. This is the only way that ground deposition of the pollutant particles can be held within reasonable limits.

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CALCULATING PARTICLE DEPOSITION

The average rate of deposition of solids particles D, in tons per year per sq. mi., depends on: the rate of dust emission W, in grams per sec.; the fraction of the time b during which the wind is in the direction of a 45-deg. sector under consideration; the horizontal distance X from the source, in feet; the wind velocity V in feet per sec.; the free-fall velocity f of the particles, in feet per sec.; the effective height H of the stack, in feet; and the fraction p of the particles which are within given grade limits of particle size μ, in microns.

With the exception of f and H the values of these factors can be obtained by measurement or analysis of the relevant data. To determine f, in addition to the particle size grading it is also necessary to know the particle density σ, in grams per cc. Knowing particle size and particle density σ, the free-fall velocity for each size range of the particle can immediately be read from Fig. 1.[1]

The effective stack height H (actual height plus height of the plume) can be calculated accurately by the method outlined in Part II of this article,[4] or if an approximation only is needed, then the actual stack height may be used for H.

Bosanquet, Carey and Halton[1] developed the following equation from which the average rate of deposition D in tons per year per sq. mi. can be evaluated with the aid of Fig. 2:

$$D = 1.12 \times (Wb/H^2) \times 10^6 \times F[(f/V), (X/H)] \qquad (1)$$

where values of F $[(f/V), (X/H)]$ are given in Fig. 2.[1] The actual equation for Fig. 2 is:

Problem in Deposition of Particles Discharged From Stacks

Given:

Effective stack height = H = 150, 250, 350 ft.
W = 20 tons/day = 20/0.0954 = 210 grams/sec.
b = 0.3
X = 2,000 ft.
V = 15 ft./sec.
σ = 2 grams/cc.

Particle size distribution:

μ	1 — 10	10 — 22	22 — 44	44 — 55	microns
p	0.357*	0.188*	0.136†	0.319†	

To find: Average rate of particle deposition D at X = 2,000 ft. from stacks of 150, 250 and 350 ft. in height.
Solution: Find f from Fig. 1 for each particle size range by taking the mean of each particle size; then calculate f/V:

μ	1 — 10	10 — 22	22 — 44	44 — 55
f	0.005	0.0495	0.22	0.45
f/V	0.0003*	0.0033*	0.0147†	0.03†

Since values of f/V under 0.0125 have a negligible effect on deposition rates, figures marked with an asterisk(*) and corresponding sized particles and particle size fractions p can be neglected.
Calculate X/H for each stack height:

H	150	250	350
X/H	13.3	8	5.7

From Fig. 2 find values of $F[(f/V), (X/H)] = F(A)$ and tabulate:

X/H	13.3		8		5.7	
f/V†	0.0147	0.03	0.0147	0.03	0.0147	0.03
$F(A)$	0.55	1.2	0.69	1.7	0.48	1.4
p†	0.136	0.319	0.136	0.319	0.136	0.319
$pF(A)$	0.075	0.383	0.082	0.540	0.065	0.450
$\Sigma pF(A)$	0.458		0.622		0.515	

Substitute the last-tabulated values above, representing the significant values of $F[(f/V), (X/H)]$, in Eq. (1):
Where H = 150, D = (1.12) (210) (0.3) (10^6) (0.458)/150^2 = 1,420
H = 250, D = (1.12) (210) (0.3) (10^6) (0.622)/250^2 = 705
H = 350, D = (1.12) (210) (0.3) (10^6) (0.515)/350^2 = 296

* Values of f/V equal to or less than 0.0125 have negligible effect on deposition rates and so can be neglected. Similarly, the particle fractions p corresponding to insignificant values of f/V can be neglected.
† Significant values with f/V greater than 0.0125.

$$F\left(\frac{f}{V}, \frac{X}{H}\right) = \frac{2.75(20H/X)^{(20f/V)+2}}{\Gamma(20f/V)} \times e^{-(20H/X)} \quad (2)$$

The accompanying tabulation shows the solution of a typical problem, for three effective stack heights. For the range of particle sizes given the average deposition D is 1,420 tons per year per sq. mi. for a 150-ft. stack, 705 tons for a 250-ft. stack and 296 tons for a 350-ft stack.

In the chemical industry, problems of atmospheric pollution from gaseous discharges probably outnumber those caused by the emission of solid particles. Still, there are several important industries in which the latter problem predominates. From a public relations point of view, it is highly desirable that economical means should become available for eliminating all pollutants from the atmosphere. But, so long as this goal is still not within our reach, the dissipation of pollutants over a wide area is the only way in which we can limit ground deposition.

The analysis in this and the preceding articles shows how rates of deposition of solids, and ground concentration of gaseous effluents, may be evaluated as a guide to selection of stack heights. Thus the maximum acceptable limits of deposition or concentration will not be exceeded.

NOMENCLATURE

- b Fraction of time during which the wind is in the direction of a 45-deg. sector under consideration.
- D Average rate of deposition of particles at distance H from source, tons/year/sq. mi.
- f Free-fall velocity of particles of diameter mu (μ) and density sigma (σ), ft./sec.
- F Function of.
- H Effective stack height = actual stack height plus plume, ft.
- p Fraction of particles within given grade limits of particle size.
- V Wind velocity, ft./sec.
- W Rate of dust emission, grams/sec. (Tons/day ÷ 0.0954 = grams/sec.).
- X Horizontal distance from source, ft.
- μ Particle diameter, microns.
- σ Particle density, grams/cc.

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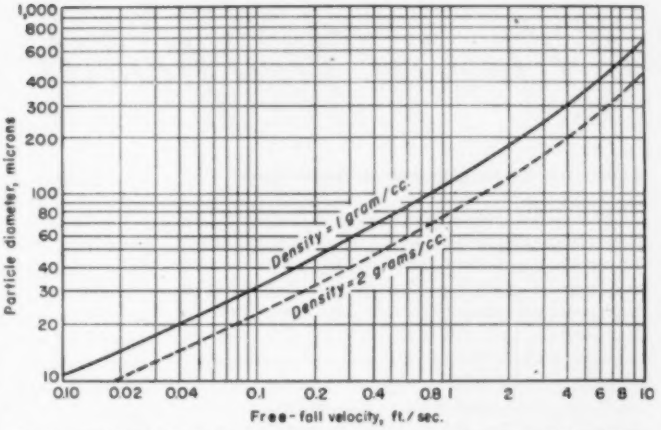


Fig. 1—Free-fall velocity in air of particles of densities of 1-2 grams/cc. (After Bosanquet, Carey and Halton).

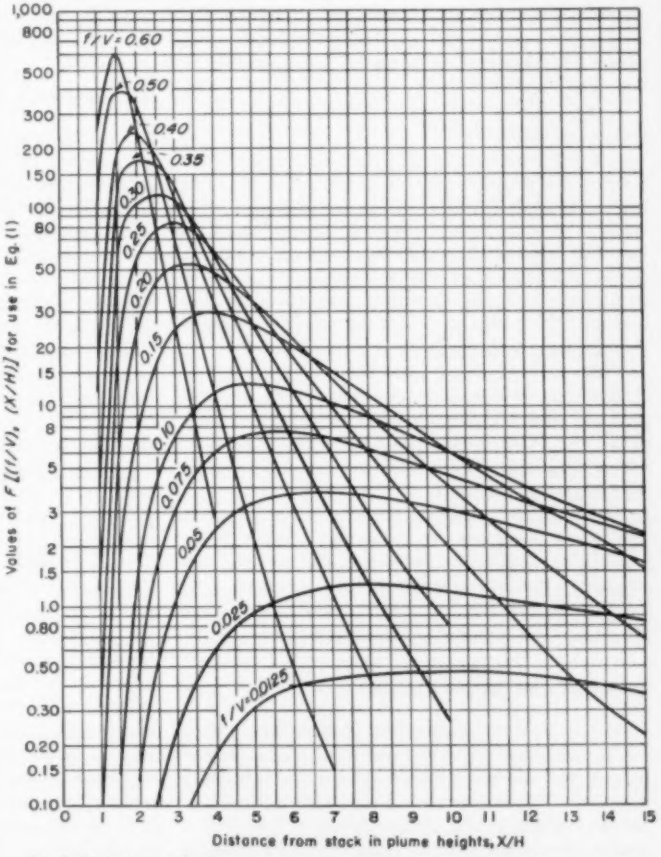


Fig. 2—Variation of deposition rate for various particle sizes and distances. (After Bosanquet, Carey and Halton).

Editorial Viewpoints

Training of Engineering Assistants

One of the more obvious ways of stretching your engineering manpower is to use subprofessional assistants for the routine and repetitive work which unnecessarily burdens many capable engineers. But where do these assistants come from, and who trains them for their work?

Prof. Richard Shaffer of Pratt Institute has offered a logical solution to the problem—upgrade your own employees by sending them to engineering schools on company time and expense. This requires, of course, that you be willing to invest financially in the training program, during which time the employee is drawing his pay but is not engaged in productive activities. But Shaffer cites some figures which indicate that any company undertaking such a program could expect to recover its investment in two years, while at the same time expanding its technical activities beyond previous manpower limitations.

A trainee, thinks Shaffer, should have had some previous college work, preferably at least two years, not necessarily in technical subjects. A group of trainees would take a ten-weeks' course at an engineering school, spending approximately 150 hours in class and 300 hours in study. They would cover such subjects as mathematics, physics, chemistry and chemical engineering. Their training would be directed insofar as possible along lines of their employer's interests.

Many companies who now are attempting to train their own engineering assistants would welcome, we feel sure, any workable program which would relieve them of this task. Others who should be interested are those companies who find it impossible to carry on any training program of their own.

Prof. Shaffer's proposal puts the job of education right where it belongs—on the college campus. Many engineering educators will also recognize a corollary advantage—that of maintaining high enrollments.

We believe this scheme is deserving of serious thought by the chemical engineering profession.

Dollars and Days Ahead

Good news on construction projects these days is all too infrequent. It was a real satisfaction therefore to learn that cost and time estimates can sometimes be decreased. We are referring to the major expansion of atomic facilities at Oak Ridge started in 1949 with a quarter of a billion dollars worth of gaseous diffusion units designated as K-29 and K-31.

Design for the new units was based on experience with the original K-25 and its later companion unit K-27. These have been operated by Carbide and Carbon Chemicals Co. and the same organization has been engaged to operate the new ones.

The following remarks were made recently by Dr. G. T. Felbeck, a Carbide vice president: "By very fine cooperation with the Atomic Energy Commission, the architect-engineering firm of Giffels & Valet, the Maxon Construction Co. and numerous other contractors and suppliers, we completed the K-29 addition to the Oak Ridge diffusion plant five months ahead of schedule and at a cost of 64 per cent of the estimate. The K-31 addition is running nearly a year ahead of the original schedule. The cost will be 65 per cent of the estimate."

Our congratulations to all concerned.

To Increase British Productivity

Recognizing the inadequacy of chemical engineering research in Great Britain, the government is at last doing something about it. A thoroughly competent committee of engineers and educators under the chairmanship of Herbert W. Cremer has recently completed a frank and most illuminating report. It is addressed to the Advisory Council of the British Department of Scientific and Industrial Research, presently headed by another leader well known to American chemists and chemical engineers, Sir Ian Heilbron.

The Cremer committee report, obtainable from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y., for 40 cents is worthy of careful study. It sets up in orderly fashion a program of governmental, university and industrial research that could well carry Britain to a dominant position among European countries. The pattern is quite comparable to that we have followed in the United States. Emphasis is divided between research on the basic unit operations employed in industry and investigations to provide the practical quantitative data required for the design of processes and equipment. Because facilities for the latter have been inadequate, Britain finds that many of her process industries "are now operated . . . under foreign licenses or in plants either purchased from abroad or constructed to foreign designs." Another frequent commentary referred to the delay in Great Britain in utilizing new discoveries made by her own scientists. Again the remedy lies in chemical engineering research and larger scale development work.

As Herbert Cremer has pointed out on other occasions, British educational institutions have been all too

slow in recognizing the basic role of the chemical engineer in industry. The present report may provide a "rude awakening" for those who would still stick to the classical pattern of the past. Yet if Britain is to increase the strength and productivity of her industries, there is no better way to start than through well-organized chemical engineering research.

Achema X Invites You

If you are planning to go to Europe this spring, don't overlook Achema X in Frankfurt am Main, May 18 to 25. By long odds it will be the year's biggest gathering of European chemists, engineers and executives engaged in chemical industry. Achema X combines a giant exhibition of chemical apparatus, materials and equipment with an international congress of the leading scientific and engineering societies of Germany, France, Switzerland, and several other European countries.

The German chemical expositions have an interesting history. They date back to 1920 when the first Achema was organized by the late Dr. Max Buchner who was then the guiding spirit of the unique organization familiarly known as "Dechema." The latter is of much broader significance than its full name (Deutsche Gesellschaft für Apparatewesen) implies. It is, in a sense, a unifying agency that brings together the scientific, engineering and production interests of the German chemical industry. For example, it sponsors important programs in product and equipment standardization and in safety in laboratory and plant operations. It serves as a clearing house for data on corrosion and other properties of construction materials. Under the leadership of its energetic chairman, Dr. Herbert Bretschneider, it has done much to promote progress through friendly cooperation and mutual understanding among European engineers and industrialists.

Those who visited Achema IX in 1950 reported many interesting discoveries and worthwhile observations. This year promises even more.

Mr. Engineering in the Oil Industry

Luck played only a minor part in the way the M. W. Kellogg Co. got into and grew up with the oil industry. The star performer was M. W. Kellogg himself, the company's founder and owner-manager through most of its years of existance.

His greatest skill lay in recognizing good engineering ideas. He set up his company to bring these ideas along through the development and building stages to actual industry installations. The formula worked time and again, to the benefit of the whole oil industry.

A good example of the kind of ideas Mr. Kellogg liked to cultivate was the first and most basic of the modern thermal-cracking processes. In 1924 a small outfit named Gasoline Products Co. came to Kellogg with the process which it couldn't get started. Within ten years Kellogg had built some 130 units over the U.S. and the world.

The combination thermal refinery unit, developed by Kellogg, permitted multiple use of vessels and furnaces and eliminated intermediate piping and tankage. Thus the whole plant could be operated from one control room.

Around 1939 the company bought out its catalytic reforming process, hydroforming. During World War II, seven Kellogg-designed hydroformers outproduced the entire coal-tar industry in supplying toluene.

Mr. Kellogg took an early interest in fluid catalytic cracking. From pilot plants in his labs came much of the basic data that went into these units. The company has since designed and erected more than 50 of them.

Outstanding wartime achievement of the company was the engineering of the $500 million U-235 plant at Oak Ridge. The job was done by a specially formed subsidiary, Kellex Corp.

M. W. Kellogg, master of all these calculated risks, died at 79 on February 22. He leaves behind him a business that has been and is a unique force in oil. The stamp of its technology is on the 500 refineries it has built for major companies all over the world.

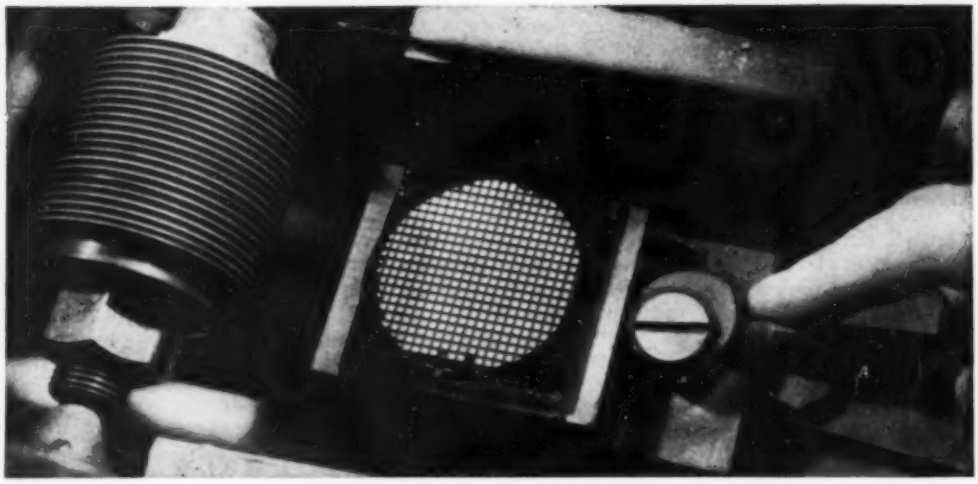
New Boost for Ammonia

Uncle Sam has decided that the capacity for production of synthetic ammonia will not be enough for security, even when the numerous plants recently projected are completed. Hence, D.P.A. has issued certificates of necessity for new ammonia capacity to be built by each of ten companies.

At the beginning of 1950 ammonia plant capacity was approximately 1540 thousand tons of N per year. Some of those plants have enlarged their capacity on their own initiative. Additional plants have been authorized in earlier certificates of necessity. The total production when that earlier program was done was to be 2430 thousand tons. That will now be increased by nearly 500 thousand tons more when the new projects just authorized are ready for operation.

Officials explained that military demand for nitrogen products might suddenly become very large if a major war started. Even without anything bigger than the Korean fighting there seems to be no surplus capacity beyond that needed for the military and for industrial and agricultural uses—leaving only very small quantities for export. The newly authorized capacity is certainly going to be necessary if estimates of the U. S. Department of Agriculture are even approximately correct as to the rapid growth in fertilizer demand expected by 1955.

The rate of growth in this chemical demand seems likely to increase steadily as grassland agriculture is adopted more widely.



WAFER OF GERMANIUM is cut by diamond saws at Sylvania's Boston plant. Scarce metal costs about $340 a pound.

Germanium's Electronic Upsurge

Advent of the transistor, tiny rival of the vacuum tube, ushers in new electronic era, suddenly lifting demand for this rare and costly metal now urgently needed. Here's how sole producer wins it from zinc ore.

JOSEPH A. O'CONNOR

Germanium has suddenly become important to the electronics industry. Why? Because, as a semiconductor, its ability to carry current can be changed, and a current flowing through it can be controlled. Hence its use in power rectifiers and the new transistors.

While germanium has about 42,000 times the resistance of copper, it has far less resistance than glass or mica.

In semiconductors, such as germanium, there may be only one current-carrying electron for every million atoms (unlike a metal, which may have one to every atom). But, and this is the significant thing, the number of carriers can be varied more than 1,000-fold by changing the electronic structure; for example, by introducing certain impurities. Thus current through the semiconductor is controlled.

Germanium behaves strangely in other ways. Its resistance increases with heat up to 165 deg. C., but then it decreases (just the reverse of usual conductors). And germanium expands on cooling. This could mean that its alloys, possibly with precious metals, might find new uses.

JOE O'CONNOR, *news editor of* Chemical Engineering, *got the story of germanium production right from* Eagle-Picher, *also watched reduction of the dioxide and growth of single crystal germanium in* Sylvania's *lab.*

MOUNTING DEMAND

How much germanium will the mushrooming electronics industry need for rectifiers and transistors? Perhaps 15,000 to 20,000 lb. a year by 1955—maybe more. Some estimates run as high as 40,000 lb. by 1956.

In recent years, production has been about 1,000 to 2,000 lb. annually. One estimate puts 1948 production at 1,000 lb.

Advent of the transistor brought an upsurge in demand. Heavy-duty power rectifiers will take more germanium than transistors, which require only a tiny piece weighing about 0.005 g. But transistors, as amplifying devices, will probably find a greater variety of uses.

Last year, according to Dr. Ralph Bown of Bell Telephone Laboratories, germanium output was 5,000 to 6,000 lb. He puts potential production, in an emergency, at 15,000 lb.

Germanium is far from abundant, and future demand may outstrip supply. No immediate shortage threatens, however, and additional processing units are likely to be set up before one does.

OTHER SEMICONDUCTORS

At Purdue, Dr. Karl Lark-Horovitz and Dr. Randall M. Whaley have developed new alloys that combine germanium with such gases as nitrogen, as well as other elements such as copper, silver, magnesium, titanium or uranium. These alloys are all *n*-type, having excess electrons.

Germanium, of course, is not the only semiconductor. Silicon, selenium and copper oxide are used in rectifiers. Silicon rectified microwaves in World War II radar. Kennecott Copper Corp. has just started recovering selenium and tellurium at its new copper byproducts refinery in Utah. At Reading University in England, researchers are studying other semiconductors such as lead sulphide, lead selenide and lead telluride. Titanates of iron,

copper, vanadium and chromium, as well as reduced titania, are also semiconductors. Workers engaged in Project Lincoln at MIT, under the direction of Dr. F. W. Loomis, are keeping an eye on all of these new semiconductor substances. One way to eke out the scant germanium supply would be to use some of these other semiconductors.

GERMANIUM SOURCES

Germanium is widely distributed, occurring in traces (0.001 percent or less) in many ores and minerals, especially sulphide ores of silver, lead, tin, antimony and zinc. Few minerals contain more than a few thousandths of a percent, however. In 1886, Clemens Winkler discovered germanium in the rare silver mineral argyrodite ($4Ag_2S.GeS_2$), which contains about 6 to 7 percent. Another mineral, germanite ($7CuS.FeS.GeS_2$) contains about 8 percent. Germanite was found at a lead-copper-zinc mine at Tsumeb, South West Africa, but is now believed to be exhausted. Certain coals contain germanium, and it can be recovered from flue dusts. Germanium ore has recently been found under the District of Columbia. But the principal U. S. source at present is the zinc sulphide ore of the Tri-State area of Missouri, Kansas and Oklahoma. This ore contains from 0.01 to 0.10 percent germanium.

BRITISH PROCESS

In Great Britain, the General Electric Co. Ltd. teamed up with Johnson, Matthey & Co. Ltd. to locate flue dusts containing germanium in quantities that could be recovered and to develop a commercial process for getting out the germanium. Both goals have been achieved. Flue dusts from producer gas plants burning certain coals have been found to contain germanium and gallium in various proportions, which may reach as high as 2 percent. More often, however, they run to 0.50-0.75 percent only.

The recovery process, worked out at the Wembley research laboratories of Johnson, Matthey & Co., has now been pilot-planted successfully, and is ready for full-scale production. The dusts contain iron, silica and alumina, together with the volatile elements lead, zinc and arsenic. Iron is a good collector of germanium.

By smelting the dust, therefore, with soda and lime as fluxes for the silica and alumina, and with copper oxide and carbon to provide copper to collect the gallium, a copper-iron regulus can be obtained that contains 90 percent of the germanium and 80 percent of the gallium.

The regulus generally contains 3 to 4 percent germanium and 1.5 to 2 percent gallium, the germanium extraction being about 90-95 percent and the gallium 50-60 percent. A further extraction of about 20 percent of the gallium can be obtained by re-smelting the slag with copper oxide and coal dust.

The regulus is next converted into a solution of the chlorides of the metals with a current of chlorine in a dilute solution of ferric chloride that acts as catalyst.

Crude germanium tetrachloride is distilled from the resulting solution, fractionated to remove most of the arsenic, and finally rectified through a column packed with copper turnings to remove the rest of it. After hydrolysis of the resulting tetrachloride, germanium dioxide is obtained with less than 0.1 ppm. of arsenic.

WHO MAKES IT

So far, Eagle-Picher Co. is the sole producer. But other companies are eyeing the germanium business. Many companies report finding germanium in their stack residues either from zinc or coal. Another factor is that germanium is a byproduct of cadmium recovery, and AEC needs cadmium.

Producers of electrolytic zinc are likely prospects. Companies like Anaconda, American Smelting & Refining and American Zinc in the United States and Consolidated Mining & Smelting in Canada might get into the business. Anaconda won't say whether it's interested in germanium.

The Tungsten & Chemical Division of Sylvania Electric Products Inc. has developed processes for extracting germanium dioxide and reducing it to the metal. A plant expansion is under way at Towanda, Pa., and it wouldn't be surprising if Sylvania started producing powdered germanium metal this fall. Vice President John Merrill at Towanda won't comment on this, however. The extraction process might start with a crude zinc oxide containing germanium dioxide.

WHAT IT COSTS

Price of germanium has been reported as $180 to $200 a lb. Right now, however, Eagle-Picher sells it for about $340 a lb. But little germanium is sold as metal. Most manufacturers of electronic devices prefer to buy germanium dioxide and reduce it themselves. Eagle-Picher currently gets about $142 a lb. for dioxide.

HOW PROCESS ORIGINATED

Paradoxically enough, germanium, now highly prized, was once the offending culprit that interfered with electrolysis of zinc. Nobody bothered much about the presence of germanium in Tri-State zinc ore until an attempt was made to purify it by electrolysis in the late '20s. Despite all efforts, the zinc simply wouldn't electrolyze properly. F. G. McCutcheon, now manager of Eagle-Picher's zinc smelter at Henryetta, Okla., attacked the problem. After much research, he identified the offender—a trace of germanium.

When roasted zinc ore is leached with sulphuric acid to form a zinc sulphate solution for the production of electrolytic zinc, germanium and other impurities in the ore are dissolved in the leach liquors. Unless removed, germanium seriously interferes with electrolytic deposition of zinc. Sludges from the purification of these leach liquors, therefore, contain germanium, together with any cadmium, gallium and indium in the ore. This was the clue to the first commercial recovery of these metals. And it is these sludges that are now tempting producers of electrolytic zinc.

From his experience in detecting and trying to get rid of the unwanted germanium, McCutcheon built up knowledge that was invaluable in recovering and concentrating the small traces of germanium in the zinc concentrate shipped to the smelter at Henryetta. He probably produced the first germanium from Tri-State ore, and certainly had a big part in developing the crude germanium recovery process.

EARLY RESEARCH

McCutcheon was not the only one interested in germanium. For many years chief chemist H. R. Harner of Eagle-Picher's research laboratories at Joplin, Mo., had been working on its recovery. In 1938 he began research on methods of extracting and purifying germanium from smelter residues. After years and despite many failures, in cooperation with McCutcheon in the later stages, he finally developed the first commercial unit for separating relatively pure germanium. At this time there was no market for germanium, but even so the research went on.

By 1941, with McCutcheon at Henryetta and Harner at Joplin working together, a pilot plant was successfully producing relatively pure germanium. Helping to carry out the pilot-plant work were E. G. Hollman, C. C. Habeger, Leo DeClue and John Sommerville.

Then came World War II, and not long after the U. S. entered the conflict, government officials came to Eagle-Picher for germanium. It was

needed for wartime research in electronics. Now comes the most incredible part of all. The government men brought back the word that the germanium wasn't pure enough—even though it was 99.99 percent pure. After almost a year, working against time, even that problem was licked.

While Eagle-Picher pioneered in production of germanium, much credit is due to workers at Purdue University, particularly Dr. Karl Lark-Horovitz and Dr. Randall M. Whaley, who carried out research on germanium that led to many current uses of the metal in electronic devices. These Purdue researchers cooperated with Eagle-Picher in the development of methods for manufacturing the metal.

HOW PROCESS WORKS

Eagle-Picher gets germanium, cadmium and gallium by first roasting the zinc concentrate to convert the sulphides to oxides, then adding coal and salt to the crude zinc oxide and sintering at high temperature. This converts the oxides of germanium, cadmium and gallium to the chlorides. The chlorides of cadmium and germanium volatilize, and are collected for further processing. The main recovery step involves distillation of germanium tetrachloride.

GETTING ZINC CONCENTRATE

To recover 1 lb. of germanium, about 1,250 tons of ore rock must be handled—20 freight car loads. Without zinc recovery, it would be almost impossible to separate the germanium, and the cost of such separation would be exorbitant.

As it comes from the mines, ore rock contains about 3 percent zinc and lead, a very little cadmium and an almost infinitesimal amount of germanium.

Ore is hauled to the huge Central Mill of Eagle-Picher at Commerce, Okla., the largest zinc concentrating plant in the world. During the war, it handled 18,000 tons of rock per day.

Here the ore is dumped into hoppers that hold several trainloads at a time. Giant crushers break the rock up into pieces no larger than 1½-in. in size.

At this point, the rock from the mine is a mixture of waste rock and ore-bearing rock. The ore-bearing rock contains most of the sphalerite or zinc sulphide ore. Cadmium and germanium are mixed with and locked in the particles of sphalerite.

This ore-bearing mineral is heavier than the waste rock, and can be separated from it. A mixture of ferrosilicon and water is made in a huge cone 20 ft. high; the density of this mixture is adjusted so that when the rock is poured into it, the lighter waste rock floats and is skimmed off, while the heavier ore-bearing rock sinks to the bottom of the cone. This separation removes 70 percent of the original mined rock as waste, leaving most of the mineral values in the remaining 30 percent of the rock.

The partly concentrated ore is further crushed through rolls and finally ground wet to very fine size in a ball mill. This releases the zinc-bearing minerals, which also carry the cadmium and germanium and lead mineral, from the remaining waste rock.

Finely ground ore is separated from the waste rock by froth flotation. The mixture is stirred with water and chemical reagents in tanks and then air is bubbled through the suspension. The mineral-bearing ore is wetted by the reagents, while the waste rock is not. The air and reagents make a froth, and the small particles of ore stick to the froth, which rises to the surface and is skimmed off. The waste rock, which is not wetted, sinks to the bottom of the tank and is drawn off and discarded. Froth containing the valuable minerals is collected.

In the three or four days since the ore rock left the mine, the metal values have been greatly increased. The zinc concentrate now contains 60 percent zinc as the sulphide, together with about 0.3 percent cadmium and 0.01 percent germanium. Even at this point there is less than a quarter pound of germanium in a ton of concentrate.

SMELTING AND SINTERING

The zinc concentrate is taken to the smelter at Henryetta, Okla., where the first step is roasting. Concentrate is fed into a huge furnace nearly as long as a city block and 30 ft. wide. Here it is heated and stirred and slowly pushed forward. As this occurs the sulphur is burned from the zinc and replaced with oxygen until, at the end of the furnace, the zinc sulphide or sphalerite in the concentrate has been changed to a crude zinc oxide.

This roasting step does not further concentrate the zinc and cadmium and germanium, but only converts them to their oxides. This crude zinc oxide is mixed with coal and salt, then sintered at a high temperature. The salt combines with the germanium and cadmium, forming the chlorides. These chloride vapors are condensed and collected by passing them through an electrostatic precipitator.

Crude zinc oxide, after this sintering, which removes cadmium, germanium and other impurities, is mixed with more coal and smelted to zinc metal in large retorts heated by gas. This zinc is the primary product from the mined ore, and carries much of the cost of recovery. Major cost of germanium today is that of purification since the fumes from which it comes are a byproduct of zinc production.

Starting with ore rock from the mines, 3 percent of this is recovered as zinc and lead concentrates. From the zinc concentrate, about 60 percent of this weight is recovered in zinc from the retorts and about 1.5 percent as fume or dust by electrical precipitation.

DISTILLING TETRACHLORIDE

High purity is essential in germanium for electronic uses. According to I. J. Kaar, manager of engineering for the Electronics Division of General Electric at Syracuse, N. Y., "less than one part per hundred billion of some impurities have an observable effect." Thus even the initial purification of germanium by the producer is a tough job. Arsenic, in particular, is hard to get out.

Arsenic must be completely eliminated before reduction to the metal for, although arsenic volatilizes readily below the melting point of germanium and does not appear to form any compounds with germanium, the last traces cannot be eliminated by prolonged heating of the metal with hydrogen.

Germanium is purified by distilling its tetrachloride from strong hydrochloric acid solution. Germanium tetrachloride boils at about 85 deg. C. and arsenic trichloride at 130 deg. C., but it's almost impossible to separate the two chlorides completely by fractional distillation, since arsenic trichloride is appreciably volatile in the vapor distilling from a solution of germanium tetrachloride in hydrochloric acid.

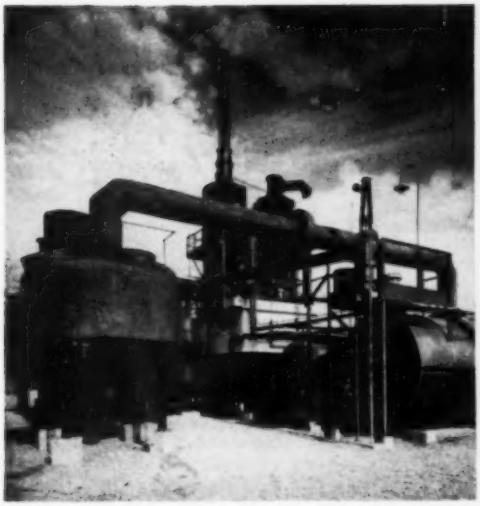
Bubbling chlorine through the solution keeps some of the arsenic in the non-volatile pentavalent form, but even so a back reaction occurs with formation of arsenic trichloride and chlorine.

One way to get rid of the arsenic is to reduce it to the metallic state. But this has to be done carefully to avoid simultaneous reduction of the germanium tetrachloride to the dichloride, which is not volatile.

The problem can be solved by using copper turnings. They react with the arsenic trichloride to form cuprous chloride and copper arsenide, but germanium tetrachloride is unattacked. Refluxing over copper must be continued for some time to eliminate the arsenic completely.

Purified tetrachloride is then dis-

(Continued on page 290)



Oxidation

Reduction

NEWS IN INORGANICS

An old line industry has suddenly become dynamic. Machinations atomic and political, defense needs, rapid amortization, inherent growth potential, cross fertilization of technology—all have contributed to new development, sometimes at the roots, sometimes at the fringes. We suggest a new look at this old segment.

CHEMICAL ENGINEERING REPORT—APRIL 1952

Not too many years ago, nobody ever expected anything startling to come from the inorganic branch of the industry—and usually nobody was jostled with any radical new developments. But then World War II came along. Need for and production of inorganics skyrocketed. A few years later we found ourselves right in the middle of an atomic age. Uranium and all of its rare earth and rare metal cousins came along and the government got into a billion dollar bomb business. Many inorganics took another turn upward, others came from obscurity to crowd the million dollar class. Then came the threat from the East and another round of increases—the biggest in our history. We set about asking ourselves, What does this mean to the inorganic segment of our industry? In some cases, it meant immediate and tremendous expansions with processes that were known to be inefficient. In other cases it meant adopting, now, new techniques that would have been more comfortably adopted 10 years hence. In still other cases, it meant that some of the complacent barons of basic chemicals were suddenly threatened by brash new producers with an assist from a generous, sometimes panicky Uncle named Sam. In all cases it meant progress—at a high price to be sure—but progress just the same.

We thought we would like to report, to you, some of what is going on. It's a big industry, so we took a small piece of it—oxidation and reduction. Not the destructive oxidation that decays metal, but constructive synthesis and reaction. We have presumed to report on some of the things we consider newsworthy and significant.

We hope that by indicating such things as the exciting pace of the rocket fuels, the new horizons in high temperature and high pressure reactions, the new language of the rare metals, the new technology reckoned in temperatures of the sun—we hope that with these modest efforts we can focus attention on an industry too long neglected, too long deprecated, too long stunted.

Strong Oxidizers

Oxygen is boosting production of steel and sulphur; other oxidizing agents—hydrazine, ozone, nitrogen tetroxide—may rocket to industrial importance.

Tonnage Oxygen

Many oxidizing gases and liquids, while of chief interest to organic syntheses, are nonetheless of great potential value to inorganic production.

Primarily for steel

The first of these, oxygen in tonnage quantities, is probably of primary interest in the production of steel. Late in 1948, an oxygen plant built for Bethlehem Steel by Air Reduction Co.[1] went into operation. Bethlehem subsequently found that blast furnace production increased 10 percent through the use of oxygen in the bath. Another successful use of tonnage oxygen is that of the Consolidated Mining and Smelting Co. of Canada, Ltd.[2] This company is using oxygen in sulphuric acid manufacture after having redesigned an old contact plant to handle, on a cyclic basis, a mixture of 25 percent sulphur dioxide and 30 percent oxygen. By doing this, capacity of the obsolete 35-ton-per-day unit was soon approaching 200 tons of 100 percent sulphuric acid.

Smelting sulphide ores

The use of oxygen has also been suggested for the smelting of sulphide ores.[3] Here it will permit a more concentrated sulphur dioxide to be formed and this, in turn, will have its effect on the manufacture of the acid. As a result of the reduction in the amount of inert gases, high throughput with better heat economy will be possible in contact sulphuric acid plants.

Canadian Industries, Ltd. is building a plant to take advantage of this fact. Here's what they did. The company built a 350-ton-per-day oxygen plant for International Nickel Co.[4] Inco uses the oxygen to flash smelt pyritic nickel ores, thereby ups production and saves on coal consumption. Besides these advantages, the gaseous byproducts of the ore smelting contain 70 percent SO_2 instead of the usual 1.5 to 8 percent.

The natural consequence was for C. I. L. to step in and build a plant to recover the SO_2 and that's just what they did. The new plant, next door to Inco's plant at Copper Cliff, Ont. will have an annual capacity of 90,000 tons, the equivalent of 45,000 tons of elemental sulphur.

Oxygen's price

Interest in tonnage oxygen has, for a long time, been centered around its price. Not long ago, a plant had to produce (and therefore use) about 500 tons per day to be economic. However, recent refinements in the Linde-Fraenkl and other designs have cut down power needs, investment and maintenance costs, so that much smaller plants may be able to straddle the break-even point in some cases.

Liquid oxygen, too, has come in for some share of attention. Its production has permitted use of the element in explosives and special fuel combinations.

Hydrazine

The progress in jet propulsion has given an unheard of thrust to liquid propellants that were mere laboratory curiosities just a few years ago.

Hydrazine in jets

Hydrazine and its hydrate, for instance, have been stirring up quite a furor in jet propulsion and, as is usual, its developers have also pushed the search for peacetime commercial uses of the liquid. It is axiomatic that if a highly reactive substance of very simple chemical structure can be prepared cheaply on a large scale, it will find innumerable uses.

Along these lines, two developments are worth watching: (1) two years ago hydrazine cost $9 per lb. Now, current processes indicate the possibility of production at considerably less than $1 lb.; (2) the possibility of direct synthesis from the elements which, if it works, would bring the price to a few cents per pound on a tonnage basis.

Ozone

Another interesting propellant is liquid ozone, until very recently an extremely hazardous substance.

Although the details on ozone are a closely guarded secret, it is well-known that the Germans considered it possible to bombard New York City from launching platforms 4,000 mi. away. They failed because they were unable to control the explosive tendencies of the beautiful blue gas, but in the U. S. workers at the Armour Research Foundation have recently solved this problem.

Peacetime uses

As in other fuels developed for rockets, its producers are keeping an eye cocked for peacetime uses. Ozone is one of the most powerful oxidants known, topped only by fluorine in oxidation potential. Although no details have been reported, work is in progress to use the gas to catalyze both organic and inorganic reactions as well as to oxidize a great variety of organic wastes.

The gas is made commercially by electronic irradiation of air or oxygen. The finished product usually contains only one or two percent ozone by weight.

Nitrogen Tetroxide

Another oxidizing agent born of rocket technology is nitrogen tetroxide. Its high oxygen content (70 percent) makes it ideal for rockets which must carry their own oxygen to burn other propellants such as alcohol.

Power aplenty

Comparing rocket fuels on the basis of pounds of thrust obtained per pound of fuel consumed per second, nitrogen tetroxide possesses more energy than hydrogen peroxide, red fuming nitric acid and mixed acid. Its high density would permit small, compact fuel tanks another important consideration for the men who think in terms of reaching the moon.

Nitrogen tetroxide is high in potential availability. It has been estimated that 500,000 tons per year could be produced by converting less than 10 percent of total ammonia output to tetroxide.

Oxidation

High pressure, low-cost ammonia, and recovery of sulphur from H_2S are the highlights in the present picture of inorganic oxidations.

The oxidation of atmospheric nitrogen to ammonia is an industry that is developing faster at this moment than ever before in its history.

3 Million tons

Some thirty years ago, no commercial synthetic ammonia was produced in the U. S. A little more than 10 years ago, Solvay's Hopewell, Va., works and Du Pont's Belle, W. Va., plant were producing 85 percent of the little more than 500 tons turned out by the country. Today, our production is crowding 1.8 million tons and less than two years from now, the figure will be close to 3 million tons.

Process-wise, this is the way the industry has been going. With the exception of the recent University of Wisconsin process and the original Claude process, most of the Haber modifications (Haber accounts for virtually all of the synthetic ammonia produced) have gone into a "melting pot" and emerged with a surprising degree of uniformity. The recent trend has been to approach a pressure of about 350 atm. (5,000 psi.) Many producers have found these lower pressures more economic.

Purer catalysts

Much attention has been given to catalysts too. Experts have found that the slightest traces of impurity in a catalyst may act either to promote or inhibit a given reaction far out of proportion to its concentration. The purity of the produced ammonia gas has also come in for a bit of scrutiny. Most producers permit only a few parts per million of carbon monoxide, oxygen, sulphur and phosphorus in order to prevent catalyst poisoning.

But probably the most important development has been the use of natural gas as a source of hydrogen. The gas is mixed with steam and passed over a nickel catalyst at about 1,300 deg. F. to form hydrogen and carbon monoxide. The CO reacts with steam to form more hydrogen. It takes about 22,000 cu. ft. of natural gas to produce enough hydrogen for one ton of ammonia. Balance that against the 1.4 tons of coke required for water gas and the scales are tilted heavily in favor of the more than $20 raw-material-cost saving made possible with natural gas.

Cheaper with oxygen

On the other hand if tonnage oxygen, rather than air is reacted with coke, a producer can realize a 30-percent saving on coke and 56 percent on steam.[8] Of course, most of the coke saving is cancelled out by the price tag on the oxygen so natural gas still seems to be ahead, at least while the supply holds out and the price stays within reason.

Of the 17 new synthetic plants and expansions announced or under way in 1950 and 1951, most are known to be using natural gas as a source of hydrogen and at least two are using byproduct hydrogen.

An even newer idea is the partial combustion of natural gas with tonnage oxygen but practically no work has been done with it.

Claude, up to Date

An interesting new adaptation of the Claude process by the Mississippi Chemical Corp. at Yazoo City, Miss.,[9] uses synthesis pressures (1,000 atm.) in the methane reforming step. An iron catalyst, rather than nickel, is used and temperatures are 730 to 930 deg. F. Only about half as much catalyst is used and its life is twice as long. Carbon monoxide impurity is low enough to be practically insignificant.

In the synthesis reaction (where 1,000 atm. pressure is also used) two converters in series are used as well as gas steam recirculation. Temperature in the first converter is 900-1,150 deg. F. (depending on catalyst activity); conversion is about 80 percent.

Less catalyst needed

Besides high conversion per pass, another advantage of the 1,000 atm. pressure is that only about one-seventh as much catalyst is needed to produce the same quantity of ammonia and only about one-fifth as much gas must be handled on the basis of actual volume at synthesis conditions. Catalyst life (a carefully purified magnetic iron oxide, doubly promoted with small percentages of aluminum and potassium oxides) is only about three months but the small volumes used help offset this loss. Carbon steel is being used with no serious corrosion problems.

Initial and operating costs have proved to be very considerably lower for this plant.

Direct Oxidation

Potentially, the most important new idea of all in nitrogen fixation has been the so-called University of Wisconsin or Food Machinery process. Although it has been known since the time of Cavendish that you could produce nitric oxide by heating air above 3,600 deg. F. and chilling it very quickly, the old electric arc process commercialized by Atmospheric Products Co. in 1922 was put out of business 20 years later by Haber. But in 1939, at the suggestion of Frederick G. Cottrell work was begun on an efficient, economical method for regenerative heating and cooling of gases.[7]

Terrific temperatures

Briefly, ordinary air is heated above 3,800 deg. F. (some reports have indicated temperatures as high as 4,200 deg. F.) by means of gas heating. At this temperature nitrogen and oxygen in the air react directly to form nitric oxide, giving a concentration of about 3 percent NO. Equipment used to reach these high temperatures originally consisted of two beds of calcined periclase. Air is preheated by passing through the first pebble bed which removes most of the heat. Heat exchange facilities are excellent. The flow of air is then reversed and the second bed becomes the preheating bed while the first bed is used to conserve heat from the exit gases. There is adequate time for the formation of nitric oxide and temperatures of the exit gases are dropped so rapidly in the pebble bed that the nitric oxide is cooled before decomposition can occur.

Next, cooled gas passes over a bed of silica gel which absorbs the nitric oxide as well as catalyzing the oxidation of nitric oxide to nitrogen dioxide.[8] A small quantity of hot gas dissolves the nitrogen dioxide and finally the gas stream con-

taining NO_x is absorbed in water to form nitric acid. Very recently, a patent[9] has been awarded for a newer recovery method which utilizes silicon dioxide as the adsorbent of nitrogen dioxide. No further details are yet available. Gas mixture, in a dried and cooled state, is passed through a mass of adsorbent SO_x, later separated.

Plant going up

Right now, the $2 million plant of Food Machinery and Chemical Co., under construction at Lawrence, Kan., will represent commercialization of the process that had its beginnings in a 1939 research, went through an extensive pilot-plant development. Work reportedly cost $700,000. The commercial plant to be operated for the Army will produce 40 tons per day of 100 percent nitric acid.

Besides being one of the most important processes in recent years, the Food Machinery work has greater significance. It may provide valuable information for super high temperature chemistry. The pioneering work with super refractory materials of construction will certainly be valuable to the industry.

Sulphur from H_2S

The world-wide shortage of sulphur is renewing a great deal of interest in processes to recover elemental sulphur from H_2S.

All of these processes consist of a primary oxidation reaction of $H_2S + 3/2\ O_2 = H_2O + SO_2$.[10] This is followed by the sulphur forming reaction of $2H_2S + SO_2 = 2\ H_2O + 3S$. There is also a secondary direct oxidation: $H_2S + 1/2\ O_2 = H_2O + S$. This takes place in a reaction furnace.

10 Percent from H_2S

Nine plants to recover sulphur from sour gases are now in operation. Total capacity of these is about 680 tons of brimstone per day. Ten more plants and one plant expansion are expected to be operating by the end of '52. Capacity then should be about 1,250 tons of sulphur per day. Besides this, at least a half dozen such plants are under consideration, some of which may be built during this year. If all were built, total capacity would be as high as 1,700 tons per day, or potentially from 500,000 to 600,000 tons per year. This is as high, potentially, as 10 percent of our brimstone requirements.

Reduction

The phenomenal increase in production of elemental phosphorus, the intense interest in the production of the no-longer-rare metals, and new techniques for winning metals from their ores—these are the newsmakers in inorganic reductions.

Bigger, better furnaces

The process of reducing rock phosphate to elemental phosphorus has seen little change in the last 50 years. The growth of the industry and the rise in electric furnace technology, however, are elements of a different breed.

Phosphorus has come up from an alchemist's seething brew in 1669 to an expected 200,000 tons in '52. A little less antiquated, electric furnace reduction of phosphate rock to the element dates back to 1897.

Powerful trinity born

The years between, though, have seen several distinct rebirths: The first about 1935 when such phosphorus titans as Monsanto, Victor and TVA began putting together electric furnaces. Production then was 21,500 tons of elemental phosphorus. The second spurt was touched off by World War II. Output in 1940 was less than 50,000 tons, by 1944 it had hit a peak of 85,000 tons. But by far the biggest rise is taking place right now. During this year production should hit 200,000 tons and by the end of 1954 when a rash of new furnaces is completed, the new peak should be 260,000 tons or four times the wartime peak ten years earlier.

In the electric furnace production of elemental phosphorus, the basic reduction reaction is:

$$\underset{7.2\ \text{tons}}{Ca_3P_2O_8} + \underset{1.43\ \text{tons}}{5C} + \underset{2.66\ \text{tons}}{3\ SiO_2} \xrightarrow[\text{Kwh.}]{11{,}850} \underset{1\ \text{ton}}{2P} + \underset{3\ \text{tons}}{5\ CO} + \underset{7.1}{3\ Ca\ SiO_3} + \underset{0.09\ \text{tons}}{\text{Ferrophosphorus}}$$

Temperature of the reaction usually runs 2,300-2,750 deg. F. The coke reduces free phosphorous pentoxide to elemental phosphorus vapor. The iron in the rock is reduced, immediately reacts with some of the phosphorus to form ferrophosphorus.

While this is being written, there are some 30 electric phosphorus furnaces in operation or under construction. These have a total rated capacity reported at 232,000 tons (or put another way, they reduce 1.5 million tons of phosphate rock).

Victor bidding high

Victor Chemical Works has announced its intention to bid for the title of "the world's largest producer of phosphorus and phosphate products," with a $20 million investment spread out over '46-'52. This year the two furnaces at Silver Bow, Mont., are expected to go on current, bringing the company's total to seven.

Monsanto, long the leading producer, is constructing its sixth phosphorus furnace—25,000 kw, largest in the world—at Monsanto, Tenn. It also has under construction a furnace at Soda Springs, Idaho, which may be using a rotating hearth. These two new furnaces bring Monsanto's total to 12.

Westvaco goes west

A recent bidder for eminence in the element is the Westvaco Div. of Food Machinery & Chemical Corp., a pioneer in the development of western phosphates (which amount almost to three-quarters of total U. S. reserves). The company is sinking $21.4 million into two furnaces built and two more being built at Pocatello, Idaho. Capacity of the four furnaces will be rated at 37,000 tons.

Food Machinery's contribution, abetted by Victor's and Monsanto's, will eventually bite off 30 percent of U. S. production of phosphorus for the West.

Better Reduction Furnaces

A recent and really important commercialization was the rotating electric furnace described in mid '51. (*Chemical Engineering*, July 1951, pp. 108-111; March, 1952, p. 238) TVA engi-

neered it, has more than a year's successful operation under its roof. The hearth of the furnace rotates very slowly (once every 100 hr.) The roof of the furnace is stationary, connects to the hearth by means of a molten lead seal.

Rotation saves wear

Designed to prevent rapid wear under the electrodes, TVA's 7,500-kw. furnace uses a higher power concentration than usual stationary furnaces, produces phosphorus with up to 15 percent less power consumption. The furnace can also directly smelt unagglomerated phosphate fines instead of the more expensive lump or sintered phosphate rock. The added life of the furnace lining becomes especially significant in light of the fact that a complete shutdown and replacement of a furnace hearth runs the order of $400,000 for a 12,000-kva. furnace.[11]

Although the rotating hearth is new to this country, the Norwegians have worked with the idea since 1937, supplied basic data for TVA's furnace. So far, several of the phosphorus producers, including Monsanto, have shown a keen interest in TVA's rotating furnace.

As a further example of the way revolving electric furnaces seem to be catching hold in this country, a Norwegian company, Electrokemisk, A. S., is designing two 24,000-kw rotating furnaces—though, not for phosphorus but calcium carbide. These will be just under Monsanto's "largest electric furnace in the world," (24,000 kw.; Monsanto's—25,000), but certainly will be the largest rotating furnaces (Monsanto's is stationary).

Uranium from phosphate

Byproduct news in phosphate rock is the fact that western and Florida reserves have been reported to contain anywhere from 0.2 lb. to 0.8 lb. uranium per ton of rock.

In 1950, latest year for which figures are available, the U. S. mined a total of 11,114 long tons of phosphate rock, a boost of roughly 23 percent over 1949. Of this total, 9,612,000 tons came from Florida and the West. At either the higher or lower uranium content after substracting 1½ tons that go into electric furnaces, it doesn't take much arithmetic to see that that's a lot of potential uranium.

And AEC has its eye on all of it. Wet process acid looks like the best bet for recovery so far but only about one million tons of rock go into it. Electric furnace phosphorus, of course, leaves nothing to work over, but most of the fertilizer processes, including the new nitric acidulation of phosphate rock, provide a good chance for uranium recovery assuming reasonable economics can be worked out.

So far Dow has a pilot plant at Pittsburgh, Calif., to recover uranium; Tennessee Corp. has a larger unit at East Tampa, Fla. In addition, Blockson is putting in a recovery unit at Joliet, Ill.; International Minerals & Chemical Corp. is also engineering uranium recovery into its $10 million plant near Bartow, Fla.; Virginia-Carolina too is active in byproduct uranium operations.

Producing the "Rare" Metals

Of all the elements now known, over two-thirds are metals. Only a dozen or so of these are really common. But thanks in large measure to the curiosity of the chemist and the physicist, and the enterprise of the chemical and the nuclear engineer the mettle of the 1952 metals industry is in a state of progressive flux.

This year titanium and zirconium will provide substance for jet engines that will carry a man from Chicago to New York in a matter of minutes; lithium, lightest of the elements may provide the explosive substance for the hydrogen bomb; and rhenium heaviest of the elements, looks like a good bet for the electronic equipment to guide such a bomb with great accuracy over fantastic distances. New producers and tremendous tonnages in the works for aluminum, a new process for cobalt and uranium, new uses for germanium, gallium, hafnium—such has been the tenor of recent news.

Because of the complex character of these metals it seems desirable to review them according to some of the better known processes for their manufacture.*

Reduction with Hydrogen

Producing germanium

Germanium is one metal that may be recovered by reducing the oxides in the presence of hydrogen.

Germanium comes from three sources: (1) from the mineral germanite, (2) from flue dusts and ashes resulting from burning coal which contains the metal (10-20 ppm), and (3) from the refining of zinc ores.

Of these, coal will probably turn out to be the best source eventually.

In recovery operations, the element is separated from common metals by distillation of germanium tetrachloride from strong hydrochloric solutions. The trick of refining germanium is to separate it from the arsenic with which it is always associated. Specifically, arsenic content must be kept below 1 ppm. and, although the boiling points of the chlorides of the two metals are 45 deg. apart, it is very difficult to separate them by fractional distillation. Separation is accomplished by reducing the $AsCl_3$ to the dichloride. It's done with copper turnings with which arsenic trichloride forms cuprous chloride and copper arsenide. Unaffected $GeCl_4$ is distilled from the copper, hydrolyzed in ice water to form GeO_2. The dioxide is fairly soluble in water so recovery operations are necessary at this step.

Reduction is tricky

Next comes the reduction—in two stages:

1. The dioxide, in a graphite boat, is heated in an electric furnace in the presence of hydrogen at 900-1,100 deg. F. Heating is carried on until water is no longer evolved. (Temperature control is necessary at this step. If it goes above 1,300 deg. F. volatile monoxide may be lost and beads of the metal may form.)

2. The temperature is slowly raised to 1,800 deg. F. to melt the metal into an ingot.

Producers of the metal are the Eagle-Picher Lead Co., Joplin, Mo. (largest producer) and the Saratoga Laboratories, Inc., Saratoga Springs, N. Y. Producers of germanium dioxide are the Donora Zinc Works of the American Steel and Wire Co., Donora, Pa., and the National Zinc Co., Bartlesville, Okla. Practically all of the

germanium produced in the United States comes from the smelting of germanium-rich zinc ores mined in Missouri, Kansas and Oklahoma. The zinc sulphide in these ores contains about 0.01-0.1 percent Ge.

Because of the small volume of the metal, production figures for recent years are not readily available. However it is known that relatively large expansions are taking place.

Almost all germanium goes to the electronics industry for making germanium diode crystal units which are used for rectification of high frequency currents, displacing certain types of vacuum tubes. The new transistors hold tremendous promise for communications equipment, guided missiles and similar uses.

Rhenium reduction

Another metal produced by hydrogen reduction is rhenium.

Rhenium, said to be the heaviest substance known, has as high a melting point as tungsten and a higher electron emission—a property which makes it extremely valuable to manufacturers of high-vacuum electronic equipment. The metal also has a longer life, at any given temperature, than tungsten.

Richest source of the metal is molybdenite ore which contains from 0.6 to 0.7 percent molybdenum and only 0.0001 to 0.05 percent rhenium. However, the flue dusts from roasting may contain up to two or three percent of the element which may be substituted for tungsten in many applications.

Although the metal may be recovered by electrodeposition, it is usually more desirable to produce the metal in powdered form by reduction of the heptasulphide obtained by saturating a hot acid solution of potassium perrhenote with hydrogen sulphide. The sulphide, being non volatile, reduces smoothly at a red-heat in hydrogen. The process leaves something to be desired since the precipitate is somewhat bulky and difficult to handle. It oxidizes on drying and for that reason must be introduced into the reduction tube while wet. The reduced metal usually contains some sulphur.

Reduction With Metals

Reducing with aluminum

Although aluminum is a very powerful reducing agent, it has a strong tendency to alloy with most metals, contaminating them.

It is, however, suitable for use with volatile metals and has been used successfully for: (1) making pure magnesium by vacuum reduction of magnesia mixed with lime to form calcium aluminate with the alumina formed in the reaction; (2) at higher temperatures, for making calcium from lime; and (3) making lithium by vacuum distillation from mixtures of its oxides and aluminum. Heat of the reaction is controlled by adding a suitable inert compound such as lime or alumina.

Aluminum reduces lithium

A process that looks more promising for the production of lithium is as follows:

1. Prepare a pure lithium salt which is very sparingly soluble, the carbonate for example. This can be done by chemical means.

2. Convert this unto aluminate or aluminosilicate by heating it with the appropriate oxides until all volatile matter is expelled.

3. Heat the product in a vacuum with aluminum powder at 2,000-2,200 deg. F. distilling out the lithium.

Reducing with calcium

Another good reducing agent is calcium. Calcium reduction can be used to reduce uranium and thorium from their oxides as well as vanadium, but information on these processes is meager.

Sodium reduction of titanium, thorium and uranium has been tried in an effort to produce these metals from their fluorides but it is not a very convenient method since it must be carried out in a closed steel vessel or bomb.

Reducing with Mg

Right now, magnesium reduction seems to be the preferred method to prepare titanium and zirconium, two of the most important metals of recent years. Molten magnesium reduces the metals from their chlorides. Foote Mineral Co. is using a tetraiodide process to produce ductile zirconium with oxygen and nitrogen impurities claimed to be below 0.010 percent. The U. S. Bureau of Mines uses a tetrachloride process at Albany, Ore., which is more economic and produces a metal of higher strength. Both processes are carried out under vacuum.

The process which seems to have the edge at the moment is the Kroll tetrachloride process, basically similar to the one used for zirconium. Titanium tetrachloride is reduced with molten magnesium at a temperature between 1,450 and 1,650 F. in the presence of an inert gas such as argon or helium.

Electrolytic titanium

Recently there has been much speculation about an electrolytic process for reduction of the metal. Research in this method at Columbia University has indicated the possibility for a lower cost metal.

Production of a powdered metal by reduction of titanium dioxide with calcium is practiced by Dominion Magnesium, Ltd., in Canada.

By the end of this year, U. S. production of titanium is expected to reach 5,000 tons a year, five times the 1,000 ton-a-year production of 1951. The two big producers Titanium Metals Corp. and Du Pont expect to be pacing the field with about 3,500 tons per year each by the end of 1952.

Hafnium is still another metal that is reduced with magnesium.

Recently, Foote Mineral Co. revealed a method to produce hafnium metal—the first commercial production in the U. S. The major problem is to get rid of zirconium impurities.

Foote's process produces a 99 percent pure metal.

First, hafnium oxide is distilled from a mixture of phosphorus oxychloride and zirconium tetrachloride (which contains about 3 percent hafnium tetrachloride).

Next the oxide is chlorinated to hafnium tetrachloride (1,750 deg. F. in the presence of carbon). Tetrachloride is reduced with magnesium at 1,200 deg. F. The sponge metal resulting is leached with HCl, washed with water.

The crude sponge is then converted to tetraiodide which is vaporized at 1,100 deg. F. and contacted with a hot tungsten filament. At about 2,000 deg. F., the tetraiodide decomposes into hafnium and iodine.

Silicothermic Reduction

Rejuvenated Pidgeon

The scarcity of magnesium has renewed interest in the Pidgeon process for reduction of magnesium ores. Early in 1951, the government reactivated four of the six silicothermic plants it had financed during World War II. Actually, the process cannot compete economically with the electrolytic reduction of ores but because it is easier to reactivate existing facilities than construct new ones, the government has called back into service the standby plants.

Briefly, the process works this way:

Pellets consisting of 4.5 parts calcined dolomite ground to 80-100 mesh, 1 part FeSi ground to mostly −200 mesh and 0.14 parts fluorspar are charged to a stainless steel retort (each retort is 10½ ft. by 10 in.; the Kaiser plant at Monterey, Calif. has 1,024 of them). The retort is then heated for 15 min. to drive off combined water. Next, the retort is closed and sealed. The pressure is reduced to 26 in. of mercury; then it is reduced to 100-150 microns (9 hr. at 2,140 deg. F.) and the following reaction takes place:

$$2\,(MgOCaO) + 1/6\,FeS \longrightarrow$$
$$2\,(Mg + CaO)_2 + SO_2 + 1/6\,Fe$$

Each retort is charged with 200-250 lb. of pellets compressed to a density of 72 lb. per cu. ft. Each charge produces 28-35 lb. of magnesium crystals. Average life of a retort is 250 days, at 2.4 charges per day. Retort cost is $925.

Electrolytic Reduction

Electrolytic gallium

The easiest method for obtaining gallium metal is the electrolytic reduction of sodium gallate in aqueous solution. However, this leaves the problem of removing the impurities of zinc, thallium, germanium, antimony, arsenic, etc.

In recent years, gallium has stirred up a good deal of interest as a heat-transfer medium. This because the metal is liquid in the range from room temperature to 3,600 deg. F.

Present producers are the Eagle-Picher Co. and the Aluminum Co. of America. The latter company recovers the metal from Bayer liquor in alumina production. In the process of crystallizing alumina trihydrate from sodium aluminate, gallium hydroxide accumulates in the liquor. After concentration and pH adjustment, the gallium is separated by electrolysis.

Producing sodium

Sodium metal is also produced electrolytically. Aside from important uses in the metals industry, the utilization of the powerful reducing character of sodium is chiefly of interest in the production of organic chemicals.

However, because of its basic importance it seems desirable to review its production.

Most sodium metal today is produced in the Downs cell which is a sectional steel vessel lined with refractory and insulating brick. The graphite anode projects upward from the bottom of the cell and is attached to the electrical connections.

The cathode is a cast steel cylindrical ring supported by two projecting iron arms that extend through the sides of the cell to the electrical connections.

The electrolyte used in the new National Distillers plant at Ashtabula, Ohio, is a mixture of salt and calcium chloride melting at 940 deg. F.

The use of this mixture with its lower melting point permits lower operating temperatures which, in turn, reduce maintenance on the cell parts. Cell operating temperature is about 1,100 deg. F. The salt is very carefully purified and dried at a high temperature to remove as much moisture as possible before being fed to the cell. The metal deposited at the cathode is pure, except for calcium which is dissolved in the sodium. Purity of sodium, as now marketed, is above 99.9 percent. Current efficiency of the cell is about 80-85 percent; voltage is about 7 which corresponds to an energy consumption of 5 kwh. of a.c. power after allowing for a 6-8 percent loss in converting from alternating to direct current.

Mn from low-grade ore

The demand for manganese metal has led to an investigation of the electrowinning of the metal from chloride electrolytes by the U. S. Bureau of Mines.[18]

In the process, low grade ores containing 25 to 35 percent manganese are used. After grinding, the ores are subjected to a reducing roast, then are leached with spent cell electrolyte containing HCl, NH_4Cl and $MnCl_2$. Impurities are removed by sulphide precipitation. After further precipitation, electrodeposition is carried out in a diaphragm cell with a daily capacity of 15-20 lb. using graphite anodes and stainless steel cathodes.

The semi-pilot plant experiments conducted by the bureau have indicated that continuous electrowinning of manganese is possible. Other distinct advantages over the sulphate process are lower power consumption and greater manganese recovery. At this date an economic comparison seems to be in order.

Battery-grade dioxide

An interesting new process for the production of battery-grade manganese dioxide utilizes a reducing roast treatment and an electrolytic exchange reaction. The newsworthy aspect of the process is that it permits, for the first time, the use of low-grade domestic ores (containing about 20 percent manganese dioxide). This circumvents the difficulty of uncertain supply of richer African ores in time of war. It also permits the large production increases demanded by present needs of the military for dry cell batteries.

The process consists of:

1. Grinding the ore (which comes from mines in southern Utah).
2. Roasting the ore to reduce insoluble higher oxides of manganese to acid-soluble lower oxides.
3. Leaching with sulphuric acid.
4. Thickening.
5. Purification.
6. Electrolysis. Manganese dioxide deposits on the anode. Sulphuric acid and hydrogen are coproducts.

Process was developed by the Western Electrochemical Co. at Henderson, Nev., in cooperation with the U. S. Army Signal Corps. It bears the name of Dr. J. C. Shumacher who directs research for Western Electrochemical Co. The firm is currently producing more than 10 tons per day of MnO_2 at its Henderson, Nev., plant, and may go as high as 50 tons if necessary.

Direct Reduction in Fluidized Bed

During recent years, the chemical industry is becoming more and more aware of the fact that some of its best ideas are coming from its sister industries. The ceramic industries give us new and stronger refractories making ultra high temperature reactions feasible for the first time; the metals industry gives us new electric furnaces, new oxidation and reduction techniques; the petroleum industry has given us the fluidized solids technique, new and better catalysts, and other technical advances.

Reducing iron ore

For that reason it seems pertinent to review the results of some interesting research in the direct reduction of iron ore using the fluidized solids technique.† This fluidization technique has developed into an extremely flexible method for handling fine solids with potentialities in almost all related fields of chemical and metallurgical engineering.

Briefly, the fluidized solids method consists of suspending finely divided solids in a moving gas stream.

A variety of ores were studied ranging from high grade magnetic concentrates and mill scale which are nearly pure iron oxide, to extremely lean tailings samples containing 75 percent silica and only 16 percent iron.

Particle sizes were all relatively fine with a large fraction passing through a 325 mesh screen.

Static tests first

In static reduction tests, it was found that 90 percent reduction of the magnetic types of iron ores occurred around 1,100 deg. F. (less than 20 min. for magnetite and mill scale at 1,100; about 30 min. for taconite at 1,000 deg.).

Above this temperature, the time for reduction is considerably longer. The hematite type of oxide behaves differently. For flue dust, (about 55 percent Fe); Mesabi ore (56 per cent); and waste tailings (16 percent); the time required for 90 percent reduction steadily decreases with increasing temperature. For the waste tailings, for instance, 90 percent reduction takes 1 hr. at 1,000 deg., 30 min. at 1,100 deg.; 20 min. at 1,200 deg. and about 10 min. at 1,500 deg.

The simplified flowsheet of the equipment used in the reduction of the magnetite concentrate is schematically shown below. The reactor, itself, was a silicon carbide tube 4 in. in diameter by 5½ ft. long.

Reduction with H₂

In carrying out a fluosolids reduction test, nitrogen gas was allowed to pass through the system and 10 lb. of magnetite concentrate was charged into the reactor tube through a removable top. The top was then replaced and the nitrogen flow increased. Next, the various heating coils brought about the desired temperature. Then hydrogen gas was introduced and the nitrogen flow was stopped. The reaction period was measured from the time that hydrogen was introduced. After a given reaction period had elapsed, gas flow was reduced considerably and the free flowing solids were allowed to drop into a 10 in. discharge cone located at the bottom of the reactor.

Slight reoxidation

When the product had cooled sufficiently, hydrogen flow was replaced by nitrogen and the entire system was allowed to cool overnight. The discharge products were then collected, weighed and analyzed. In transferring the reduced magnetite concentrate there was a tendency toward reoxidation. The results of five reduction tests are shown below.

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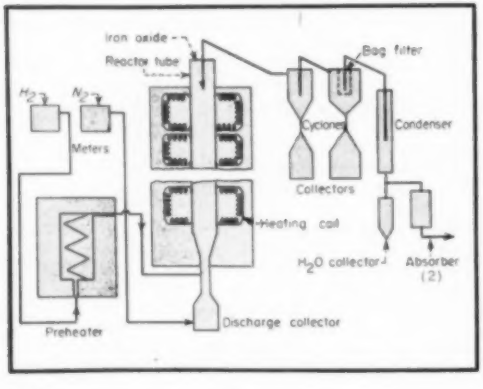
ACKNOWLEDGEMENT

*† Much of the data on the production of rare metals were supplied by Alan R. Powell in a paper presented before the Institution of Mining and Metallurgy symposium on the refining of non-ferrous metals, London, July, 1949. The material on the reduction of iron ore was abstracted from a paper by Tenenbaum, M., and Squarcy, C., Inland Steel Co., presented to the General Meeting of the American Iron and Steel Institute, New York, May 23-24, 1951.



Fluidization Reduction, Magnetite Concentrate

Test No.	Reduction Temp., F.	Reduction Time, hr.	Deg. of Reduction Percent
A	1,040	3 1/2	43.0
B	1,120	7 5/6	57.5
C	1,000	9 3/4	64.8
D	1,060	10 2/3	45.0
E	1,025	6 3/4	58.5

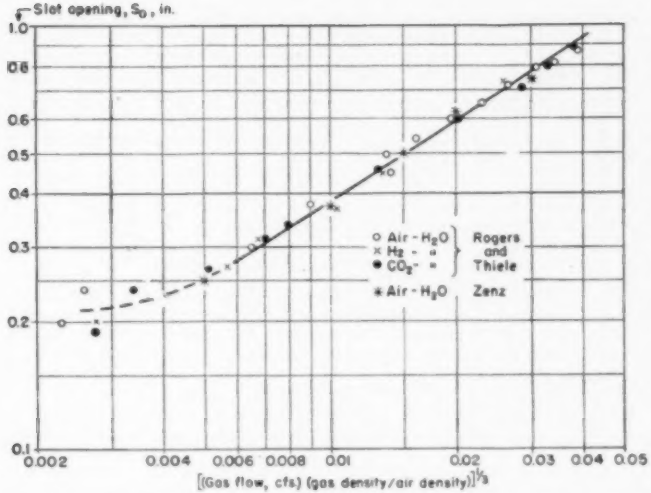


Fig. 1—Experimental tests show slot opening to be independent of the depth of liquid on the tray or cap-to-tray clearance, and only a function of vapor rate.

What Goes on Inside Bubble-Cap Towers?

Credit recent, more intelligent answers to this question for changing the conventional method of design.

Now designers are finding it to their advantage to start at the cap and work out to the tower diameter, rather than trying to fit an efficient tray into a tower diameter based on allowable vapor velocity.

FREDERICK A. ZENZ

During the past ten years, chemical engineers have found out quite a bit more about how construction details of a bubble cap tower affect its capacity and efficiency. This fostered the present shift toward tower design starting at the cap and working out to the vessel diameter rather than first finding a diameter based on an allowable superficial velocity and then hoping to fit an efficient tray into this shell.

PREVIOUS PRACTICE

In the past, design has been based on so-called allowable superficial tower vapor velocity computed from:

$$v = K\sqrt{(\rho_L - \rho_G)/\rho_G} \qquad (1)$$

Here we equate the frictional drag on a liquid droplet to the gravitational force, assuming all such droplets to be of constant diameter and also assuming the frictional drag coefficient as constant. Values of K have been reported as functions of tray spacing by substituting "satisfactory product" operating characteristics of commercial fractionators[3] and the peak efficiency loads of experimental towers in Eq. (1).

If the assumptions made in the derivation of Eq. (1) are a true representation of the physical phenomena governing entrainment, then superficial vapor velocities should be based on tower free area, neglecting the area occupied by the downcomers, which vary in size from tower to tower. It must also be assumed that cap layouts in all instances were well planned, since it is obvious that the degree of entrainment in a 5 ft. diam. column with 2 caps per tray would be far greater than with 20 caps per tray. Though the mechanism of entrainment with 2 caps per tray may no longer be the proposed droplet-carrying power of the ascending vapor, it should still be possible to establish some generalized basic criteria for the vapor capacity of a bubble cap tray. This prompts investigation of the basic phenomenon of gas and liquid contact at the cap.

LIMITS FOR SLOT OPENINGS

Vapor enters the body of liquid on a tray as it emerges through the cap slots. It is plausible to assume that the narrower the slots the better the dispersion of vapor bubbles into the liquid and therefore the greater the contact efficiency of the tray. However, exhaustive studies have shown this effect to occur only at very low vapor rates which blow slots only slightly more than ¼ in. open.

Under such operating conditions the vapor leaves the slots as bubbles, creates essentially no froth on the tray, and thus presents only bubbling surface and time of contact for effecting mass transfer. On trays operating under more conventional loadings where slots are blown ½ to 1¼ in. open, slot dimensions and liquid depths greater than about 2½ in. no longer exhibit any effect upon efficiency.

At vapor rates greater than required to blow slots more than about 1¼ in. open, the vapor creates a high velocity gas pocket or cone surrounding the cap and the contact surface per volume of vapor throughput per unit time is reduced to such an extent that tray efficiency rapidly diminishes. It would therefore appear advantageous, if not essential, to set specifications which will insure operating with slots blown open not less than 0.3 in. and not greater than 1.25 in.

FUNCTION OF VAPOR RATE ONLY

To explore the possibilities of a sound relationship between vapor load, slot opening and tray spacing a series of simple air-water tests were carried out with a single conventional 3 in. O.D. cap and compared with the similar experiments reported by Rogers and Thiele.[4] The details of the experimental apparatus have been reported earlier.[5] In the air-water tests, the slot opening was found to be independent of the depth of liquid on the

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FIG. 2
VAPOR CAPACITY OF BUBBLE CAP TRAYS

Req'd. cap area/tray, $A_c = N a_1/F$ or $N a_2/F$ whichever is larger

N = number of caps per tray, V_T / V_c

V_T = required tower vapor load, cfm

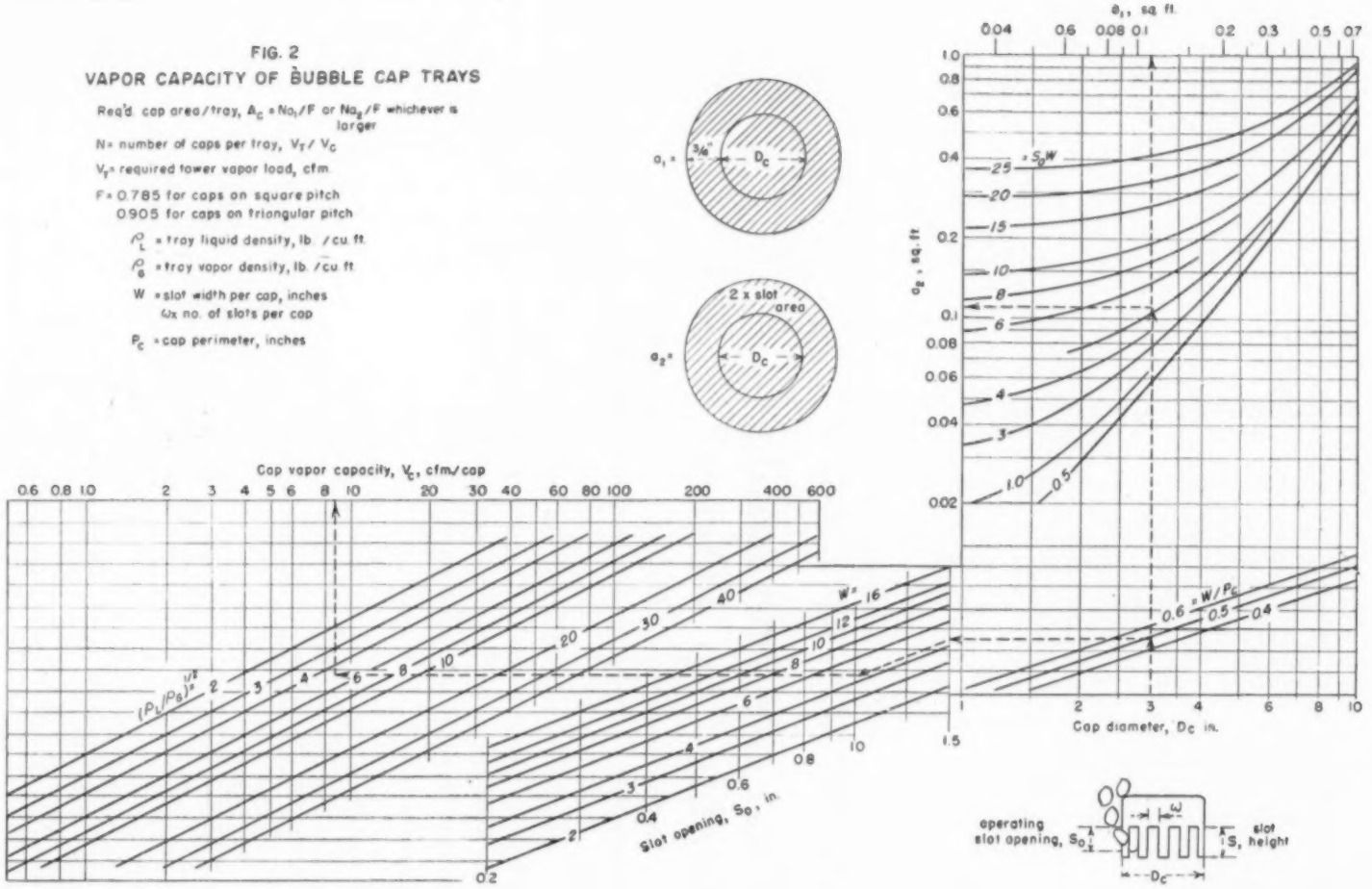
F = 0.785 for caps on square pitch
0.905 for caps on triangular pitch

ρ_L = tray liquid density, lb. /cu. ft.

ρ_g = tray vapor density, lb. /cu ft.

W = slot width per cap, inches
ω x no. of slots per cap

P_c = cap perimeter, inches



tray or the cap-to-tray clearance, and only a function of the vapor rate. The data are shown in comparison with the data of Rogers and Thiele in Fig. 1 correlated with the cube root of the vapor density rather than the square root suggested by these investigators.

These data may be conveniently represented in terms of cap vapor capacity by the equation:

$$V_s = S_s^{3/2} \frac{W}{2.43} \sqrt{\frac{\rho_L}{\rho_G}} \qquad (2)$$

(See nomenclature in Fig. 2)

This relationship, shown graphically in Fig. 2, permits calculation of the required number of caps per tray for a given vapor load, as a function of the degree to which the slots are blown open. It is general design practice to space the caps such that the annular area around the outside of each cap, in which the vapor travels upward through the liquid, is approximately twice the slot area or else that the caps are not less than 1½ in. apart. This ensures no interference between the vapors issuing from adjacent caps and therefore reduces any loss in contact volume. With these specifications for cap spacing, plus a designated design operating slot opening, it is possible to rapidly estimate from Fig. 2 the cap area per tray required to accommodate a given vapor load.

If we generalize cap dimensions by assuming rectangular slots of total width equal to one half the cap perimeter, we can for example compute from Fig. 2 or Eq. (2), the vapor capacity of a triangular pitch cap layout. Such capacity calculations are presented in Table I as a function of slot opening and cap diameter. In a recent paper Kirschbaum[6] reported an experimental investigation of the effect of cap diameter on the capacity and efficiency of an alcohol still at 200 mm. tray spacing with slots blown open 0.85 in. His data are shown in comparison to the values computed from Eq. (2) in Table II below. Note that in all instances the experimental capacities are lower than the calculated; this is due to losses in effective area at the tray periphery and allowances for added area between the outer rows of caps and the weirs. The computed values are based on perfect equilateral triangular cap layout and, as expected, the discrepancies between Kirschbaum's experimental values and the calculated are therefore smallest for the smallest caps. For the 3 ft. diameter experimental tower Kirschbaum concludes that the optimum cap diameter (based on cost and capacity) should be about 3 in.; Table II would therefore indicate that when using Fig. 2 the ideal calculated capped areas be increased in general by about 20 percent to allow for area losses at the tray periphery and at the weirs. Fig. 2 is fairly self-explanatory; however, the sample problem will more explicitly illustrate its use.

Table I—Tray Vapor Capacity—Caps on Triangular Pitch*

Cap Diam., In.	Slots Blown Open: 1/4"	1/2"	3/4"	1"
	(Cfm./ft.² of capped area)/$\sqrt{\rho_L/\rho_G}$			
1	6.78	12.7	17.4	21.4
2	4.51	9.50	13.9	18.5
3	3.40	7.60	11.6	15.9
4	2.71	6.33	9.94	14.1
5	2.26	5.43	8.69	12.7
6	1.94	4.75	7.73	11.4

* Rectangular Slots—Slot width equals 50% of cap perimeter.

Table II—Comparison with Experimental Values

Cap Diam., mm.	(Cfm./ft.² capped area)/$\sqrt{\rho_L/\rho_G}$ Kirschbaum Expt.	Eq. (2) Calc'd.	Expt./Calc'd.
50	15.2	16.0	0.95
90	8.90	12.4	0.72
145	4.71	9.5	0.50
200	3.27	7.9	0.42

FINDING TOWER DIAMETER

Fig. 3 presents a rapid graphical solution for tower diameter with a specified liquid load and a required cap area determined from Fig. 2. In using this chart it will be found that in the majority of cases vapor load or A_c will control the tower size; a liquid

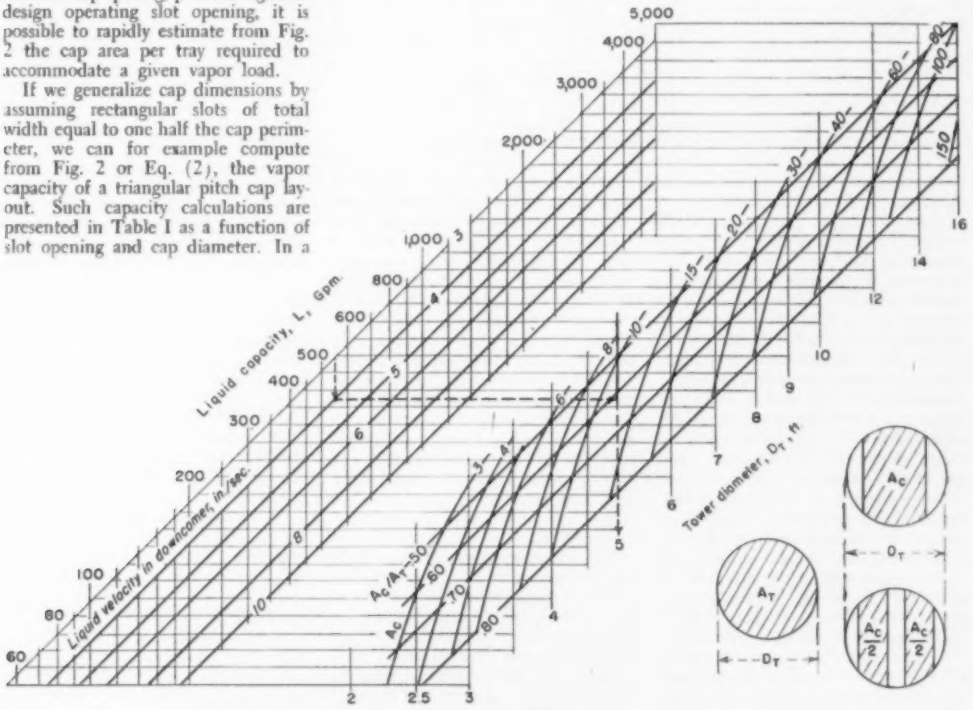


Fig. 3—Rapid graphical solution for tower diameter with a specified liquid load and a required cap area determined from Fig. 2.

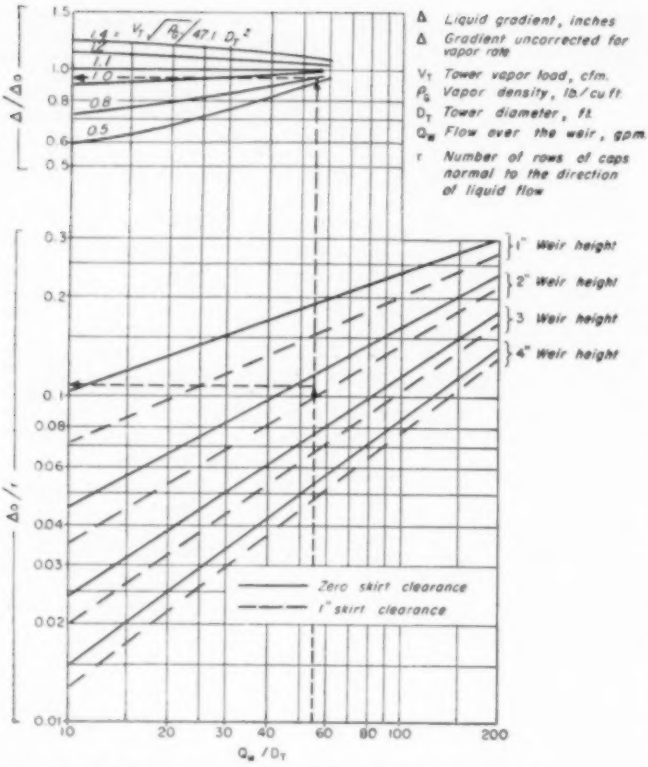

Δ Liquid gradient, inches
Δ Gradient uncorrected for vapor rate
V_T Tower vapor load, cfm.
ρ_g Vapor density, lb./cu ft.
D_T Tower diameter, ft.
Q_w Flow over the weir, gpm.
r Number of rows of caps normal to the direction of liquid flow
1" Weir height
2" Weir height
3" Weir height
4" Weir height
Zero skirt clearance
1" skirt clearance
Δ/Δ₀
Δ₀/l
Q_w / D_T

Fig. 4—Graphical method for estimating the liquid gradient across the tray.

load far greater than required may be handled (with no limitations as yet imposed by tray spacing considerations). In applying Fig. 3 consideration must be taken of the foaming properties of the tray liquid and the horizontal length of liquid travel on the tray. It would, for example, be undesirable in most instances to design a 12 ft. diameter tray as a single flow tray; thus for such a diameter the chart should be used in the A_c/A_t range of 0.5 to 0.65; it would also be undesirable to design for a liquid velocity of say 10 in. per sec. when uncertainty exists as to the liquid foaming tendencies. Allowable downcomer liquid velocities as low as 2 in. per sec. and as high as 22 in. per sec. have been encountered in practice. As a general rule it is customary to assume 4 in. per sec. for design purposes in the absence of specific information on the liquid in question.

Visual observation of bubbling trays shows that at moderate and high gas velocities the liquid is well agitated into foam occupying a zone that is higher above the top of the tray than that which would be occupied by clear liquid if no vapor were passing through the liquid. Above this zone there occurs another dense zone of droplets, the height of which depends on vapor rate and slot submergence. It is this zone that must be kept in the space between the trays. Above this zone there is a third zone composed of a fine mist that may extend, at least intermittently a distance of several feet above the middle zone and will thus always extend to the next plate. The percentage entrainment that this mist represents is small, and hence, has only a small effect on tray efficiency.

TRAY SPACING

The minimum allowable tray spacing to maintain the dense middle zone of droplets between trays is given in Table III as a function of slot aeration and submergence for the system air-water. The literature indicates a great deal of work devoted to attempts at correlating the foaming tendency of liquids with their physical properties, but as yet no satisfactory

Table III—Minimum Allowable Tray Spacing

Slots Blown Open: Slot Submergence, In.	Tray Spacing, In. 1/4"	1/2"	1"
1/4	4	9	12
1/2	4	9	12
5/8	5	10	14
3/4	5	11	16
1	6	11	16
1 1/2	7	12	18
1 3/4	7	12	18
2	8	14	20
2 1/2	8	14	20
2 3/4	10	17	24
3 1/2	10	17	24
3 3/4	13	22	30
5	13	22	30

results have been published. It is therefore recommended that Table III be used generally for liquids known to exhibit no "excessive" foaming tendencies.

SLOT SUBMERGENCE

Slot submergence may be calculated by the relationship:

$$S_1 = S_s + h_{lw} + \Delta/2 \qquad (3)$$

In using this equation the effects of weir height and skirt clearance will become evident inasmuch as the dimensions of these tray details govern the gradient and static seal terms. The gradient may be estimated from Fig. 4 and the liquid height over the weirs from the Francis weir formula. Fig. 4 was calculated from the equation presented by Davies[5] for caps on equilateral triangular spacing with a number of simplifying assumptions as to relative tray dimensions based upon existing designs. The use of Eq. (3) and Fig. 4 is illustrated in the sample problem.

The procedure outlined in the sample problem will in most instances lead to a satisfactory arrangement; however, a final layout sketch should be made and gradient and submergence calculated and checked more exactly. The layout sketch will permit calculation of safe liquid depth in the downcomers and ratio of gradient to cap pressure drop all conforming to the criteria for uniform vapor distribution to all the caps.[2]

SAMPLE CALCULATION

It is required to size a gasoline stabilizer for:

Vapor load of 750 cfm.
Liquid load 550 cfm.
Vapor density = 1.62 lb./ft.^{3}
Liquid density = 34.5 lb./ft.^{3}

NOMENCLATURE

v = Superficial tower vapor velocity, ft./sec.
ρ_L = Liquid density, lb./ft.^{3}
ρ_G = Vapor density, lb./ft.^{3}
K = A constant (function of tray spacing)
S_s = Slot submergence
S_s = Static seal
h_{lw} = Height of liquid over the weir
Δ = Liquid gradient across the tray

To calculate required cap area:

Assume 3 in. diam. caps with slots blown open about 1 in.; assume slot width per cap to be 50 percent of cap perimeter. If it is desired to install a particular available cap, then diameter and slot width may be measured and used directly in Fig. 2.

$$\sqrt{\rho_L/\rho_G} = \sqrt{34.5/1.62} = 4.61$$

From Fig. 2 (see dashed guide lines):

V_s = 9 cfm./cap

Therefore number of caps required,

N = 750/9 = approx. 84

a_t and a_s in this instance are both about equal to 0.11 sq. ft. Assuming equilateral triangular spacing the required cap area per tray is:

$$A_c = Na_t/F = 84 \times 0.11/0.905 = 10.2 \text{ sq. ft.}$$

Loss of capped area at the tray periphery and allowance for ample disengaging space at the overflow weir increases A_c about 20 percent as indicated in the text. Therefore A_c should be 12.2 sq. ft.

To obtain tower diameter:

Assume a liquid velocity of 4 in. per second in the downcomer. For a liquid load of 550 gpm. and a cap area of 12.2 sq. ft. Fig. 3 indicates a required tray diameter of 5 ft. Note that Fig. 3 shows A_c/A_T to be approx. 0.60 indicating a double flow tray.

To obtain tray spacing:

A stabilizer operates with essentially a "clean" liquid therefore not necessitating large cap skirt-to-tray clearance. Increasing skirt clearance generally reduces tray efficiency and is ordinarily used as a means of lowering liquid gradient on the tray or lessening the chances of accumulation of dirt, etc. in crude towers. For this illustrative calculation let us assume ¼ in. skirt clearance and ½ in. static seal; we now require a weir height of 2.0 in.

Therefore $Q_w/D_t = 550/2 \times 5 = 55$

From Fig. 4: $\Delta_o/r = 0.11$

$$\frac{V_t\sqrt{\rho_G}}{47.1\ D_t^2} = \frac{750\sqrt{1.62}}{47.1 \times 25} = 0.81$$

From Fig. 4: $\Delta/\Delta_o = 0.94$

$$\Delta = 0.11 \times 0.94r = 0.104r$$

Above we calculated about 84 caps to the tray or 42 to the half tray. Since Fig. 2 indicated a_t to be about equal to a_s, center-to-center distance between caps is about 4¼ in. We can therefore estimate the maximum number of caps in the longest row as:

$D_t \times 12/4.5 = 60/4.5$ = approx. 13 caps

The number of rows of caps on a half tray will therefore be at least 42/13 which is numerically equal to 3.25, say 4 rows of caps. Gradient, Δ, is therefore approximately $4 \times 0.104 = 0.416$ in.

An estimate of the height of liquid over the weir may be calculated from the Francis weir formula by assuming that the weir length on a single flow tray is 85 percent of the tower diameter and on a double flow tray only 65 percent of D_t. Thus in this instance:

$$h_{ow} = \left[\frac{Q_w}{2.98\ l_w}\right]^{2/3} = \left[\frac{550.2}{2.98 \times 0.65 \times 60}\right]^{2/3} = 1.77 \text{ in.}$$

Substituting in Eq. (3):

$$S_t = S_s + h_{ow} + \Delta/2$$
$$= 0.5 + 1.77 + 0.416/2$$
$$= 2.48 \text{ in.}$$

Form Table III the above submergence calls for a minimum tray spacing of 20 in.

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HOPPERS

(*Continued from p. 153*)

centrally above the gate. Then you would have the equivalent of two hoppers each with one vertical side. This solution is too simple: it has been tried and did not work.

There is an apparent practical basis for this very plausible idea. With a straight side, material does slide down that side and is first to leave. The observer only wishes he could have four straight sides. However, the reason material slides down the straight side is that the subsidence is always vertically above the outlet. The straight side just happens to be there.

Many different ideas have been tried to prevent arching and facilitate flow of material. One is based on the same idea about the desirability of straight sides (Fig. 2). It involves a vertical chute reaching up towards the surface and feeding to the outlet. Openings in the side take material from different levels. An idea that actually was patented uses an open-end cylinder set somewhat above the gate (and adjustable to suit the material). Idea is that material would slide down the cylinder, and that new material would keep feeding to top as required.

Compressed air and vibrators have been used successfully for easing the flow of some materials. Vibrators should not be allowed to run except when gate is open or they will pack the material.

ARCH ACTION

Something should be said about arch action. The arch is continually reforming during flow. In fact it could better be described as a set of forces in the shifting material. It is real enough to hold material in place against sloping bottom while material above gate is leaving. Action is same as for the plane of rupture described by Legue in reporting his classic experiments with sand behind a small movable retaining wall. As wall is moved a wedge of material behind it slides, not down the angle of repose, but down a "plane of rupture," located well above the angle of repose.

DESIGN PRINCIPLES

We are now ready for a statement of principles behind successful design:

1. Have gate large enough. Size of outlet should be such that proper flow develops with the gate about half-way open. Then the gate can be opened further to clear a partial choke. Size should be selected by previous experience when such is available. Size should also be large enough to pass ordinary lumps when half-open. On the other hand, if you make the gate larger than necessary, you may find it too difficult for one man to operate.

2. Have *least* slope steep enough to be self-cleaning. The valley angles are the ones to watch: they should be a little steeper than the angle of repose —steeper slopes do not help. Handbooks give the angle of repose for some materials; or the angle can be easily determined by experiment.

3. If you still insist on one straight side, do not flatten-out opposite side so that material won't run down the valleys.

Make it a principle to empty out material all the way, fairly frequently. This is especially true of material which can cake up in storage, and of material which may vary somewhat in analysis or physical appearance from time to time as it is put in storage.

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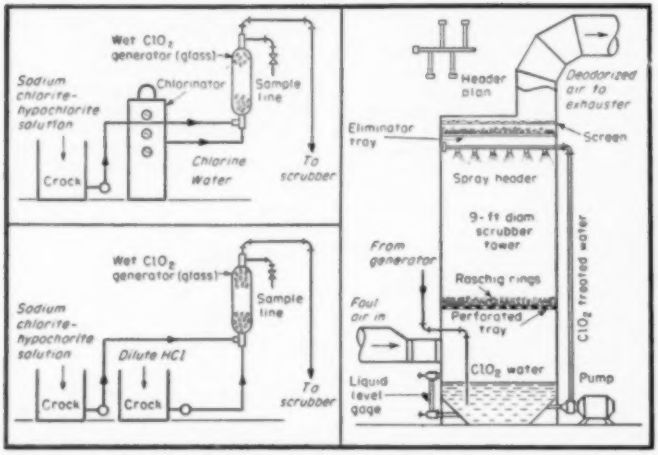
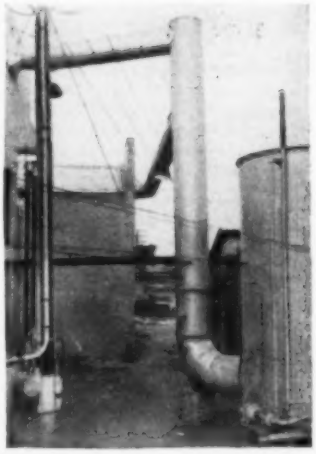


Left: Two ways to generate chlorine dioxide: At top, by chlorine; at bottom, by acid-hypochlorite activation of sodium chlorite solution. Right, odor-destroying scrubber uses water containing 100-500 ppm. chlorine as chlorine dioxide.



10 x 15 ft. tower with packed trays and water sprays deodorizes 16,000 cfm. of polluted air in a Texas rendering plant.

Odor Control With ClO_2

Recent work in several plants has shown that chlorine dioxide is effective in destroying a variety of objectionable organic odors such as those produced in fat splitting and rendering.

E. R. WOODWARD and E. G. FENRICH

Industry is becoming more and more aware of the need to find economical ways to control atmospheric pollution, witness the many technical symposiums on control measures that have been held within the last two or three years. One of the most elusive sorts of problem comes from organic odors such as those produced in fat splitting in soap manufacture, and at other types of fixed oil processing works. The problem is similar in fish meal and animal byproduct rendering plants.

Several years of practical experience with the problem have convinced the authors that an economical solution exists in the selective oxidizing action of dilute scrubbing solutions containing chlorine dioxide and chlorine in the range from 100 to 500 ppm. of available chlorine, as ClO_2.

Industrial experience in the United States in the last several years has shown that chlorine alone, or calcium hypochlorite, will not do the job satisfactorily.[6] Since the 1922 U. S. patent of Henderson and Haggard, many attempts have been made to control offensive organic odors with chlorine. Where the effect was to stop putrefaction by the sterilizing action of the chlorine, there was a reduction in odor —but in other cases there was little success. Mute evidence exists in the many rendering plants where chlorinators were installed, only to be shut down later. Chlorine has a temporary masking effect, but it does not destroy the obnoxious odors.

Ronald[9] made a comprehensive study of the problem in England, reporting that the offensive gases contained ammonia, methyl and ethyl amines, and hydrogen sulphide which were produced in considerable concentrations when fresh stock was being rendered—but could increase four to ten times or more with stale stock. These gases, being water soluble, are carried off in the condenser effluent. From laboratory experiments Ronald reported that calcium hypochlorite in the condenser water could accomplish complete deodorization with a contact time of 30 sec. and a minimum concentration of 0.35 percent as chlorine. These results, however, have not been confirmed in the United States.

McCord and Witheridge[4] mention briefly the use of chlorine dioxide in improving taste and odor in public water works. Although they devote considerable detail to the atmospheric pollution problems of the rendering industry, they do not mention the use of chlorine dioxide for this purpose.

Our first indication that chlorine dioxide might be effective in destroying the odors from rendering plants came from an experiment in New England a few years ago. Here a rendering plant was equipped with an exhaust system and water scrubber for the buildings housing the raw stock receiving, crushers and cookers. The experiment consisted in bleeding a stream of chlorine dioxide gas in air into the exhaust system at intervals. By the presence or absence of obnoxious odors, observers could easily determine whether the chlorine dioxide stream was off or on.

Later a more comprehensive experimental program was carried out at a Texas rendering plant. Here the local court had threatened to shut the plant down unless the atmospheric pollution were stopped. As a result of a small scale test in a 4-in. tile column 15 ft. high, using chlorine

E. R. WOODWARD, *Technical Service Dept., and* E. G. FENRICH, *manager of the Chlorite Dept., Mathieson Chemical Corp., Baltimore, have been working for several years on industrial applications of chlorine dioxide. Among these is the use of this chemical in solving industrial odor control problems.*

dioxide water, the management decided to go ahead with a plant-size odor control system. So satisfactory has this system been, although it is only partially complete, that complaints from the neighbors have been reduced to a minimum, and threats of court action have ceased. Plans are now under way to hook a second odor-producing building into the scrubber system. This should solve the problem completely.

In developing an odor control system for this plant it was first necessary to have a tight collecting system to confine the polluted atmosphere within the plant and lead it to the treating equipment. The solvent-extraction cookers and blood dryers were re-housed in a new tight building, connected at two points by 34-in. ducts to the base of the outdoor scrubber tower. These ducts connect to wall openings near the roof and behind the cookers. An induced-draft fan draws 16,000 cfm. of air from the building, evacuating it every 2 min. The air is then drawn up through the tower shown in the photograph. This tower is 10 ft. in diam. and 15 ft. high, with a sump in the bottom and two perforated trays each supporting a layer of coke packing.

Scrubbing water containing chlorine dioxide is circulated from the sump by a small centrifugal pump to a spray nozzle header. The nozzles discharge a curtain of water above the lower packed tray. The upper tray acts as an eliminator and so prevents undue loss of chlorine dioxide water by entrainment in the exit air.

At 70 deg. F. the solubility of chlorine dioxide in water is 2.9 grams per liter, or 2,900 ppm. For odor control purposes, 100 to 500 ppm. available chlorine as ClO_2 in water should be ample to destroy the objectionable organic odors. Requirements will vary at each plant. When optimum operating conditions have been determined, the chlorine dioxide water in the system should be tested periodically for ClO_2 content. A suitable set of color standards, indicator solutions, and a comparator can be used for this purpose. When the concentration falls below the required level, additional ClO_2 water from the generator can be added to the system.

This system is to be extended to a second building housing the melters and grease house. At that time the scrubber will be handling twice its initial load, or 32,000 cfm.

In a rendering plant in Kentucky, chlorine dioxide has proved to be equally successful in chemically destroying obnoxious plant odors. The operation of scrubber towers using a strong solution of calcium hypochlorite had failed to stop complaints from the neighbors in a residential district. The local court had enforced reduction of plant operation from 24 hr. to 12 hr. per day, and the plant operators also were restricted as to the type of raw stock they could process. Since they installed the chlorine dioxide system, they have been allowed to resume 24 hr. per day operation without restriction as to types of charging stock that are processed.

Odors originate in two buildings in this plant. Each is provided with a fan capable of evacuating the contained atmosphere in a few minutes. The effluent of each is blown through a separate square tower. The smaller tower is 3 by 3 by 15 ft. high, the larger is 5 by 5 by 20. A tank at the base of each tower serves as a reservoir from which water is drawn by a centrifugal pump and discharged to the spray header in the tower. The larger tower has 55 spray nozzles in groups at various levels. Its pump, which is driven by a 5-hp. motor, circulates 250 gpm. of water. The reservoir holds about 1,000 gal. of water which contains 100 to 500 ppm. available chlorine as ClO_2, according to the severity of the odor condition to be handled.

In a fish meal plant in New England, complaints came from a nearby colony of summer residents. A chlorinator had been installed, together with an adequate collecting system and scrubber tower. However, chlorine alone failed to kill the objectionable fishy odors. Now the chlorinator is used as an operating part of the chlorine dioxide odor control system.

Chlorine dioxide solution can be conveniently produced in two ways, using either dilute muriatic acid and hypochlorite or chlorine water as the activating agent for a solution of sodium chlorite. The equipment needed is simple. If a chlorinator is already available, as in the fish meal plant, it is used to feed dilute chlorine-water into the base of a small glass generator or tower, packed with Raschig rings, in which the reaction with sodium chlorite takes place. The sodium chlorite solution is kept in a stoneware crock and pumped to the generator by means of a proportioning pump.

If a chlorinator is not available, then the HCl activation system is used. $NaClO_2$ and NaOCl from one crock, and dilute HCl from another, are pumped by proportioning pumps to the generator. Reaction between the chlorine or the acid at room temperature and at pH below 3.5 generates chlorine dioxide in solution. The presence of ClO_2 is shown by a distinct greenish-yellow color in the water passing through the mixing chamber. These two methods are diagrammed in two of the sketches. A preferred design for an odor scrubber tower is also indicated.

In the fish meal plant the chlorine dioxide water was used to dose the condenser water which scrubs the odor-bearing vapors that come off the dryers. The plant owners have found this system so successful that they are planning to apply it to four additional fish rendering plants in other parts of the United States and Canada.

There are, in general, two sorts of organic pollution problems that can be handled with chlorine dioxide solutions. In one class of problem the odorous vapors from equipment such as the cookers in a rendering plant may be absorbed in water in barometric condensers. If water is plentiful so that it need not be recirculated to the condensers, then it is generally sewered without chemical treatment, unless stream pollution is a problem. However, if the water is restricted and must be recirculated, then it can be treated with chlorine dioxide of the proper concentration for killing the odors.

The other type of problem is the one we have just been considering, namely, where odors contaminate the atmosphere of processing buildings. In such cases, as we have seen, exhausting of the atmosphere through scrubbers sprayed with chlorine dioxide water is highly effective. To do so requires a complete air change at fairly frequent intervals, preferably every 2 or 3 min.

In the case of fat splitting operations in soap manufacture and other types of fixed oil processing, chlorine dioxide has been found to remove 80 percent of the odor at nominal expense. This performance equals that of another method which is much more costly to install and operate.

Chlorine dioxide has a selective oxidizing action that destroys many objectionable industrial organic odors. It is expected therefore that it will come to play an important part in the elimination of a number of atmospheric pollution problems that at present are the cause of much complaint.

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The Plant Notebook

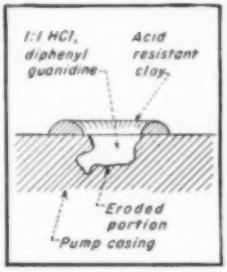
Edited by Theodore R. Olive

Chemical Etching Method Makes Rust-Free Welding Surfaces

PAUL E. KRYSTOW, *Materials of Engineering Div., Research & Development Dept., Colgate-Palmolive-Peet Co., Jersey City 2, N. J.*

★ February Contest Prize Winner

Area mechanics often have difficulty in filling eroded sections of steel or cast iron pump castings with weld metal because of inability to clean out rusted portions of the eroded casing satisfactorily. The usual method for cleaning eroded pump casings before welding requires grinding out the rust. However, this is unsatisfactory if it is not possible to place the grinding tool in eroded areas.



A special chemical etching technique is now available which does the job handily. First the eroded portion of the steel or cast iron casing is wire brushed to provide a roughened surface. Then a dam is built around the eroded portion with acid resistant clay (supplied by the Stewart Clay Co.) to prevent acid spillage. The diagram shows how. A 1:1 solution of hydrochloric acid saturated with diphenyl guanidine is then poured into the erosion. The acid dissolves all the rust inside the clay dam, but when the bare metal is reached the diphenyl guanidine deposits on the metal and stops further etching. Once the rust has been removed from the eroded area (usually over night), the acid and clay can be removed and the casting washed thoroughly with water.

This method will assure a clean, shiny, rust-free surface in the eroded area which can readily be filled in with steel or stainless weld metal and then machined to size, if necessary. Use of the etching technique can cut down materially on the number of casings discarded due to erosion and corrosion. Thus a crimp can be put into ever rising maintenance costs.

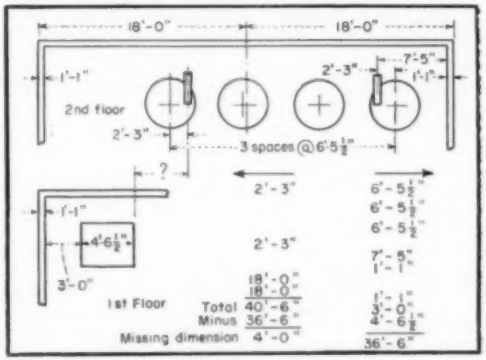
Improved Hot Cutter for Plastic Filter Cloths Avoids Fraying

F. L. CUNNINGHAM, *The Upjohn Co., Kalamazoo, Mich.*

It has become general procedure in recent years to use a hot cutter for cutting holes in thermoplastic filter cloth, as well as cutting out the cloth itself. This not only provides an easy method of cutting (as compared with punching) but also seals the material against fraying, which is even more important. The usual method has been to heat a roller knife and an arch punch or a piece of tubing of the proper size in a gas flame. This we found to be cumbersome as the cutter lost its heat and had to be reheated frequently. Also gas was not readily available in many of the areas where the cloths were being cut. Therefore, we devised self-heating cutters from electric soldering irons.

For cutting holes, an ordinary heavy-duty electric soldering iron had its point turned down to a size such that a force fit was obtained in the shank of a standard cork borer of the desired size for cutting the holes. This provides an electrically heated unit, readily portable and suitable for continuous use. We now cut (or melt) through ten cloths at one time using a slight twisting motion and a plywood backing board. This makes a clean, well-sealed hole with a minimum of labor.

The cloths themselves are cut from roll stock in a similar fashion, using a heavy-duty electric soldering iron which has had its copper point hammered out into a blunt knife. This hot knife is then drawn along a metal straight-edge across the cloth which is on a plywood backing board. This results in a fast, clean cut which is automatically sealed.



Avoid Blue Print Trouble When Adding New Equipment

CHESMAN A. LEE, *Engineer, Darling & Co., Chicago, Ill.*

Drawings showing installation of equipment at least theoretically give all the dimensions required to locate it properly. In addition, other dimensions that may be of interest are also likely to be included. However, when we have to refer to these drawings at some later time when still more equipment is to be added, we often find that certain dimensions are missing. Particularly when the new equipment is not on the same floor, it may not be immediately obvious whether it will have clearance. Installation of a new elevator is a good example.

To secure a missing dimension may require a series of additions and subtractions, with a good chance for error and confusion. This is especially likely if the one doing

DID YOU MISS . . .

. . . the February notice announcing new, higher rates to be paid to authors of Plant Notebook material, and a change in the Plant Notebook Contest?

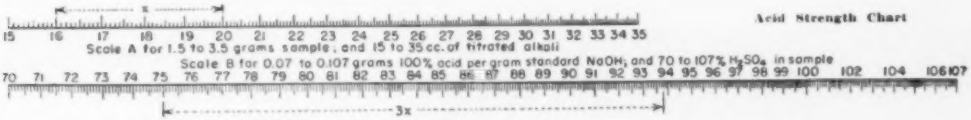
Contest—Henceforth all winning articles in the Plant Notebook Contest published during any one year will be rejudged at the end of the year and the year's best picked, to receive an additional prize of $100.

Space Rates—Space rates for non-winning articles published in the Plant Notebook will henceforth be increased by 40 percent. Furthermore, a new minimum has been established and every author of an article published in this section will receive at least $10, no matter how short his article may be.

the work is not a trained draftsman. However, there is an easy way to treat the dimensions, as debits and credits in two separate columns, so as to avoid possible trouble. The method, which is actually easier than its explanation, is shown in the table on the sketch.

Start at one end of the missing dimension and work around a complete loop until you return to the other end of the missing dimension. Put each known dimension in one or the other of two columns, depending on the direction. How this is done will be evident from the table. When all the dimensions are down, add the two columns, then subtract the sum of one column from that of the other. The difference is the missing dimension.

In making the two columns it is helpful to draw arrows at the top to show in which direction the dimension reaches.



Charts Cut Down Work for Sulphuric Acid Makers

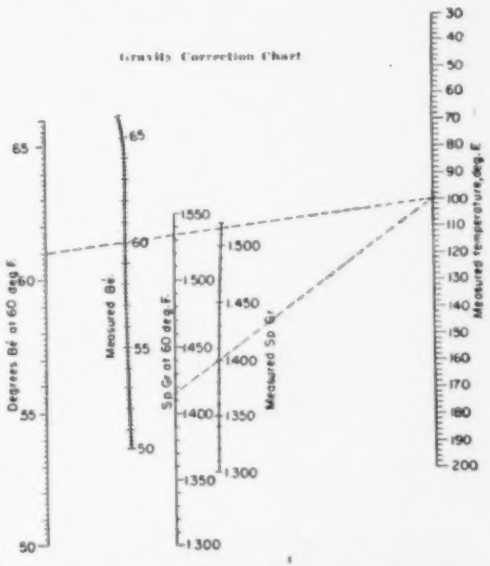
ROBERT L. RORSCHACH, *Chemical Engineer, Garfield Chemical & Mfg. Corp., Garfield, Utah.*

Here are two charts that we have found very useful in operating our sulphuric acid plant. The first, above, quickly shows the acid strength from the titration data. The second, a fairly ordinary alignment chart, corrects sulphuric acid specific gravity or Baumé density at any temperature in an obvious way to the corresponding values at 60 deg. F.

In billing our customers for acid we make charges on the basis of 100 percent sulphuric acid equivalent. Each car shipped is sampled carefully and the sample weighed and tirated with standard NaOH solution. Since calculating the results was time consuming even with an electric calculator, we devised a chart (above) which would give the analysis correct to 0.05 percent H_2SO_4. (For reproduction purposes the chart has been reduced about one-half and half the scale divisions have been omitted. For practical use the chart should be redrawn.—*Ed.*)

Both scales are logarithmic and easily constructed, scale *B* being drawn to a modulus three times that of *A* for desired reading accuracy. Scale *A* represents both sample weight from 1.500 to 3.500 grams, and volume of NaOH used for titration, from 15.00 to 35.00 cc. The *B* scale represents the strength of the standard NaOH, in grams from 0.0700 to 0.107 of 100 percent H_2SO_4 equivalent to 1 cc. of the NaOH (determined in standardizing the NaOH); it also represents the sample acid strength from 70.00 to 107.00 percent H_2SO_4.

The chart is based on the well-known formula: $P = 100TS/W$, where P is percent H_2SO_4, T is the cc. of NaOH used for titration, S is the strength of NaOH in grams of 100 percent acid per cc. NaOH, and W is the


Gravity Correction Chart
Degrees Bé at 60 deg F.
Measured Bé
Sp Gr at 60 deg F.
Measured Sp Gr
Measured temperature, deg F.
65 60 55 50
1550 1500 1450 1400 1350 1300
30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200

weight of the acid sample in grams. The chart simply sets up the two ratios T/W and P/S, by subtracting logs, thus showing the magnitude of P.

As an example of use, let $T = 20$ cc., $W = 1.6$ grams and $S = 0.075$ grams 100 percent acid equivalent to 1 cc. NaOH. Locate $T = 20.00$ and $W = 1.600$ on the *A* scale. The distance between them is *x* (see chart) which is picked off with a pair of dividers. Locate $S = 0.075$ on the

---

★ **March Contest Winner**

"How to Design a Self-Acting Decanter for Phase Separation."

A prize of $50 in cash will be awarded to Stanley Yokell, chemical engineer of Fair Lawn, N. J. Mr. Yokell's winning article will appear in the Plant Notebook section for May.

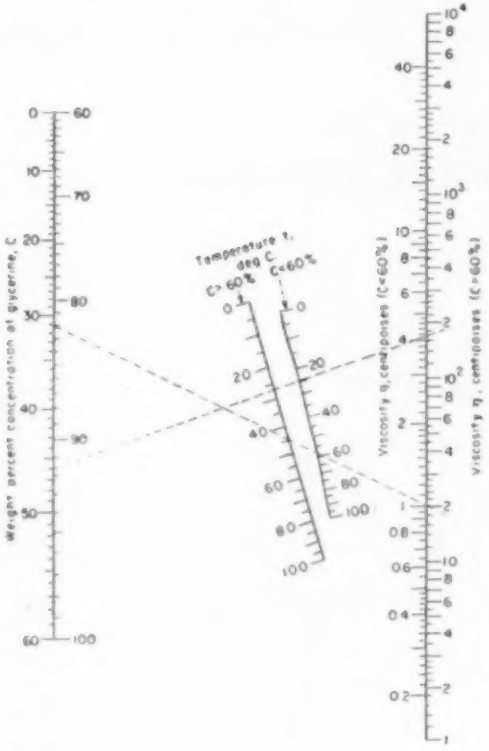
$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. Each month's winner will be announced the following month and published the second following month.

$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article, which will then be awarded an additional $100 prize.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Articles which are acceptable but are not winners will be published at regular space rates ($10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.

B scale. Now lay off the distance x three times to the right on scale *B* from 0.075. The point so located is *P*, or 93.80 percent H_2SO_4.



Nomograph for Viscosity of Aqueous Glycerine

D. S. Davis, *Professor of Chemical Engineering, Virginia Polytechnic Institute, Blacksburg, Va.*

Segur and Oberstar[3] presented data on the viscosity of aqueous solutions of glycerine that cover concentrations from 0 to 100 weight percent of glycerine and temperatures from 0 to 100 deg. C. These data, in satisfactory agreement with those of earlier investigations, are for steps of 10 percent between 0 and 60 percent, for steps of 5 percent between 60 and 90 percent, and for steps of 1 percent above 90 percent; they are also given for steps of 10 deg. C. over the entire temperature range. There is evident need for a convenient correlation and graphical representation that will permit accurate estimation of viscosities at levels of 1 percent and 1 deg. C. over the respective concentration and temperature ranges.

Since the usual means of correlation were found to be inadequate for these data, recourse was made to a method described by Mavis[2] once isotherms for log η_l vs. *C* had been drawn, where η_l is the viscosity in centipoises and *C* is the concentration of glycerine in weight percent. Special concentration scales, satisfactory for all the isotherms, were devised from the 50 deg. C. isotherm so that viscosity and concentration could be represented by the expression $\log \eta_l = m + n\,f(C)$ for concentrations below 60 percent and by $\log \eta_l = m + n\,\phi(C)$ for concentrations above 60 percent. These functions of concentrations are defined approximately by the equations $f(C) = a + bC + cC^2 + dC^3$ and $\phi(C) = a + bC + cC^2 + dC^3$, where the values of *a*, *b*, *c*, and *d* are given in Table I, as are values of *m* and *n*.

Through the use of the tabulated values of *m* and *n*, the accompanying line coordinate chart was constructed by methods described previously.[1] The left sides of the *C* and η_l axes are for concentrations below 60 percent whereas the right sides of these axes are for concentrations above 60 percent. Note, however, that the converse situation exists for the temperature scales: the lefthand scale is for concentrations above 60 percent whereas the righthand scale covers concentrations below 60 percent.

HOW TO USE CHART

The use of the nomograph is illustrated as follows: What is the viscosity of an aqueous solution of glycerine that contains 46 percent glycerine at 25 deg. C.? Connect 46 on the left side of the *C* axis with 25 on the righthand *t* scale and read the intersection on the lefthand η_l scale as 4.1 centipoises. What is the viscosity of an 82 percent aqueous glycerine solution at 45 deg. C.? Connect 82 on the right side of the *C* axis with 45 on the lefthand *t* scale and read the intersection on the right side of the η_l axis as 20 centipoises.

At what temperature will a 33 percent solution of glycerine exhibit a viscosity of 1.00 centipoise? Connect 33 on the left side of the *C* axis with 1.00 on the left side of the η_l axis and note the intersection with the righthand *t* scale as 62 deg. C.

Table II shows the nature of the agreement between viscosities read from the nomograph and those of the Segur and Oberstar data.

Table I—Values of a, b, c, d, m, and n.

	C < 60%		C > 60%	
a	0		−36.23	
b	2.5975×10^{-1}		2.0598	
c	1.1000×10^{-3}		-2.7915×10^{-1}	
d	2.0625×10^{-4}		1.5340×10^{-4}	
t, °C	*m*	*n*	*m*	*n*
0	0.2483	0.0506	1.471	0.1096
10	0.1147	0.0465	1.227	0.0986
20	−0.0002	0.0428	1.025	0.0884
30	−0.0982	0.0397	0.848	0.0804
40	−0.1847	0.0371	0.700	0.0729
50	−0.2586	0.0348	0.573	0.0658
60	−0.3272	0.0327	0.457	0.0604
70	−0.3842	0.0311	0.364	0.0557
80	−0.4407	0.0296	0.266	0.0518
90	−0.5000	0.0285	0.180	0.0475
100	−0.5457	0.0274	0.117	0.0441

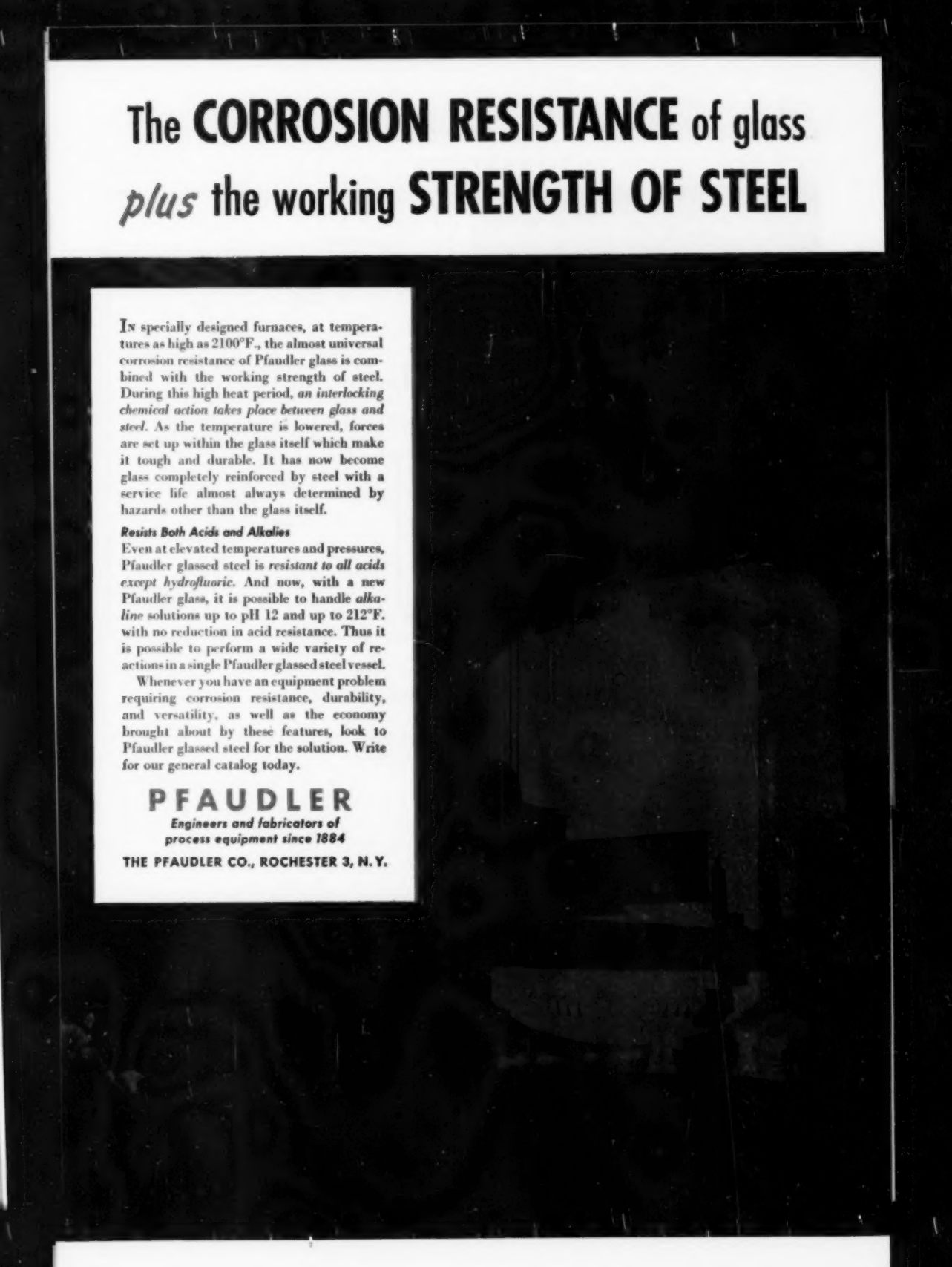
Table II—Comparison of Nomograph and Observed Results

C, Wt. Percent	*t*, °C.	η_l, Centipoises—Nomograph	η_l, Centipoises—Observed	Percent Deviation
10	30	1.03	1.03	0.0
30	20	1.77	1.76	0.6
30	10	3.60	3.49	3.2
40	40	2.07	2.07	0.0
50	0	15.0	14.6	2.7
80	40	3.08	3.10	−0.6
60	60	2.81	2.85	−1.4
80	80	5.00	5.13	−2.5
85	0	535	540	−0.9
95	0	3.700	3.690	0.3

REFERENCES

1. Davis, D. S., "Empirical Equations and Nomography," Chap. IX, McGraw-Hill Book Co., Inc., New York, 1943.
2. Mavis, F. T., "The Construction of Nomographic Charts," p. 107, International Textbook Co., Scranton, Pa., 1939.
3. Segur, J. B., and Oberstar, Helen E., *Ind. Eng. Chem.*, **43**, 2117 (1951).

The **CORROSION RESISTANCE** of glass *plus* the working **STRENGTH OF STEEL**



In specially designed furnaces, at temperatures as high as 2100°F., the almost universal corrosion resistance of Pfaudler glass is combined with the working strength of steel. During this high heat period, *an interlocking chemical action takes place between glass and steel.* As the temperature is lowered, forces are set up within the glass itself which make it tough and durable. It has now become glass completely reinforced by steel with a service life almost always determined by hazards other than the glass itself.

Resists Both Acids and Alkalies

Even at elevated temperatures and pressures, Pfaudler glassed steel is *resistant to all acids except hydrofluoric.* And now, with a new Pfaudler glass, it is possible to handle *alkaline* solutions up to pH 12 and up to 212°F. with no reduction in acid resistance. Thus it is possible to perform a wide variety of reactions in a single Pfaudler glassed steel vessel.

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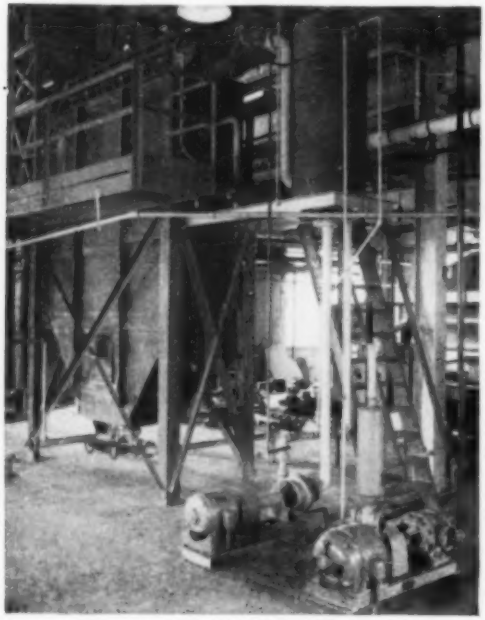
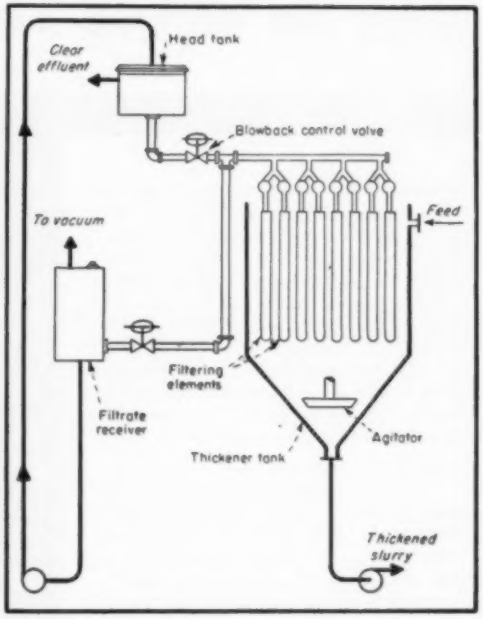




New Vacuum Thickener Handles Sticky Solids

Careful design of filter element, filter cloth and blowback mechanism provide the winning combination. Five machines are already in operation.

(180A) Filter thickeners aren't new in principle, but here is one which incorporates enough new angles to make it worth investigation.

The trouble with most filter thickeners is that they work well only on coarse solids. Whenever you have sticky or slimy materials, you have to thicken by settling or else do a complete filtration job. And sometimes settling is difficult because the solids are light and flocculent, or else elevated temperatures give rise to disturbing convection currents.

A filter thickener, to be successful, must be able to periodically remove the solids from the filter medium without build-up or permanent loss in filtration rate. Solids removal is commonly done by a short reverse blow through the filtering element.

The new Edco thickener operates on these conventional principles. The secret of its success, however, lies in those seemingly minor details which are actually all-important.

- First of all, there is the new type of filter cloth. This is the same nonplugging cloth described in these pages last October (p. 176). In fact, the new cloth was developed specifically with the requirements of the filter thickener in mind.
- Next, there is the careful design of the filtering element. It is said to provide positive drainage of the filter medium at all points and in either direction.
- Third, there is the mechanical oscillation of the filter tubes during the blowback cycle. The tubes, as a group, are simultaneously oscillated laterally, causing the filter media to assume alternate elliptical shapes. Blowback is provided by a reverse flow of clear liquid for a very short time (about 1 sec.), but at a low head (4 ft. maximum) and high flow rate. In order to get a short but effective blowback, Edco had to develop a special low-friction diaphragm-operated control valve.

A typical time cycle might take, say, 40 sec. During 34 sec. the thickener would be on vacuum, with filtration taking place at the elements. The remaining 6 sec. are used in operating valves, flooding the tubes with blowback liquid, and mechanical oscillation. Filtration occupies 85 percent of the time cycle, and the time off for blowback is so short that the operation is, for all practical purposes, continuous. Rate of withdrawal of thickened material from the bottom of the tank can be regulated with a level controller.

Five of the new thickeners have already been installed in plants making

pharmaceuticals, pigments, paper and vulcanized fiber. A typical machine has 24 filter tubes, with a total area of 124 sq. ft. Filtration rate varies widely, depending upon the characteristics of the solids; it may be as low as 2½ or as high as 200 gal. per hr. per sq. ft. Cost of a machine, in Type 316 stainless steel, complete with valves and receiver, runs about $22,000.—*Equipment Development Co., Inc.*

Impact Pulverizer In Portable Model

(181A) Powered with a 1-hp. motor and rated at 50 to 100 lb. per hr. of output, this new impact pulverizer is mounted on wheels for easy portability. It will pulverize any dry, grindable material to specifications without damaging molecular structure, it is claimed. Mill speed and fineness of the screen used determine particle size of product for any given material. —*Mead Mill Co.*

Equipment Cost Indexes

(Marshall and Stevens Indexes of Comparative Equipment Costs, 1926 = 100)

Industry	Mar. 1951	Dec. 1951	Mar. 1952
Average of all	181.2	177.1	180.2
Process Industries			
Cement mfg.	174.0	169.5	172.8
Chemical	182.0	177.5	180.8
Clay products	169.0	164.5	167.8
Glass mfg.	172.1	167.6	170.9
Paint mfg.	175.3	170.8	174.1
Paper mfg.	175.6	171.1	174.4
Petroleum ind.	178.4	173.9	177.2
Rubber ind.	180.8	176.3	179.6
Process ind. avg.	179.4	174.9	178.2
Related Industries			
Elec. power equip.	183.6	179.1	182.4
Mining, milling	182.7	178.2	181.5
Refrigerating	201.0	195.8	200.3
Steam power	171.2	166.7	170.0

Compiled quarterly for March, June, September and December of each year by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. Indexes are prepared for 47 different industries, from which the eight process and four related industries listed here are selected. Published each month with the latest available revision. For a description of the method of obtaining the index numbers see R. W. Stevens, **Chemical Engineering**, Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see **Chemical Engineering**, Feb. 1952, p. 191.

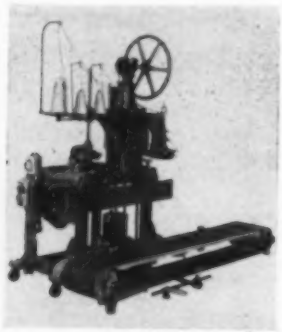
IN BRIEF—A capsulated listing of this month's newsworthy equipment.

Processing Equipment		Page
Vacuum Thickener	Handles sticky and slimy solids	180A
Impact Pulverizer	Wheel-mounted for easy portability	181A
Alumina Balls	Higher density improves ball mill efficiency	181B
Packaging and Handling Equipment		
Bag Closing Machines	For medium to large textile or paper bags	182A
Drum Filler	Permits fast filling without foam	182B
Filling Scale	Automatically weighs and bags bulk materials	182C
Fork Truck Control	Permits remote operation of lifting action	182D
Drum Cradle	For tiering of barrels and drums	182E
Vibrator Clamp	Speeds up attachment to load	182F
Bin Vibrator	Large size for heavy duty	182G
Bin Vibrator	Gives all-directional vibration	182H
Elevating Conveyor	Capacity of 25 cu. ft. per min. of solids	182I
Skid Adapter	Used with conventional hand pallet trucks	182J
Lift Truck Attachments	Carry 2 or 4 drums at a time	182K
Safety Equipment		
Hydrocarbon Detector	Measures concentration of aromatic vapors	184A
Valve and Flange Covers	Made of dynel, protect against leakage	184B
Automatic CO_2 Systems	Packaged units cost less	184C
Fog Nozzle	Connects to ordinary garden hose	184D
Fog Nozzle	Delivers 500 gpm. to 80-ft. distance	184E
Four New Respirators	Two for fumes, two for dusts	184F
Heating and Cooling Equipment		
Steam Trap	Built-in bypass eliminates separate valves	186A
Portable Electric Heater	Keeps workers warm in hard-to-heat places	186B
Electric Heaters	With vapor-tight terminal box	186C
Boiler Housing	For outdoor steam generators	186D
Tube Cleaner	Good for both hard and soft deposits	186E
Electrical and Mechanical Equipment		
Slotted Angle	For fast construction of scaffolds, etc	188A
Kel-F Gasket	Solid disk is 45 in. in diameter	188B
Variable Speed Drive	Completely self-contained, explosion-proof	188C
Gaskets and Packing	Complete line of Teflon shapes	188D
Vapor Purifier	Receiver or drum with internal separator	188E
Packing Ring	Maximum sealing efficiency in minimum depth	189A
Interval Timer	Registers up to 15 steps per setting	189B
Rotating Limit Switch	Controls travel of any rotating device	189C
Automatic Lubricator	For greasing wheels of trolley conveyors	189D
Motor Controls	Rain-tight, for outdoor use	189E
Gearmotor	Two secondary pinions provide high torque	189F
Fluids Handling Equipment		
Metering Pumps	Five new developments	190A
Airfoil Fan Blades	Increased efficiency demonstrated by test	190B
Ammonia Compressor	Unloads tank cars completely	190C
Piston Pump	Air-operated, uses mercury fluid piston	192A
Flexible Metal Hose	Special method of fabrication gives long life	192B
Flexible Hose	Made of nylon and neoprene	193A
Air Compressors	Small self-contained units	193B
Exhaust Fan	Duct-mounted, to 23,000 cfm.	193C
Tank Car Fitting	Plug valve with adjustable clearance	193D
Roof Ventilator	Louvers are actuated mechanically	193E
Instruments and Controls		
Portable Calculator	Carries to five decimal places	194A
Electronic Hygrometer	Measures dew point, controls concentration	194B
Multi-Tube Cable	Saves time and cost in instrument piping	194C
Shaft-Position Indicator	Converts angular position into digits	194D
Pressure Controller	Set point is easily adjusted	194E
Operator's Desk	Centralizes 96 temperature readings	194F
Contamination Monitor	Measures low-level surface radiation	196A
Resistance Thermometer	High voltage output and fast response	196B
Electron Microscope	Incorporates electrostatic lens system	197A
Orifice Meter	Stable coefficient in viscous flow range	197B
Temperature Regulator	Can be relapped and cleaned in field	198A
Pressure Gage	For transmitted air pressure to panelboard	198B
Instrument Pen	Eliminates flooding, reduces plugging	198C
Cleaning Machine	For cleaning delicate instrument parts	198D

Alumina Balls Improve Mill Efficiency

(181B) In line with the principle that grinding efficiency in a ball mill is in direct ratio to the density of the grinding medium, you can probably expect to achieve some improvement with the new Arlcite grinding balls, made of alumina. Their density is 3.3, compared with 2.4 for porcelain balls.

Higher densities, approaching 4.0 for pure alumina, could be provided in grinding media, but at a sacrifice in durability. The new balls are said to provide a reasonable increase in density over other media without any sacrifice in length of life.—*Patterson Foundry & Machine Co.*



Bag Closing Machines
For Textile or Paper Bags

(182A) Two new machines, Styles 21800 P and 21800 R, are designed for closing medium to large textile or paper bags. Both machines make plain sewed or tape-bound closures and have a capacity of 2,800 to 3,800 100-lb. bags per 8-hr. day. Style R differs from Style P in that it is used with a vibrating packer.

The new machines are of the table type with a portable base. They have a mounting stand and bracket for the sewing head, power-driven conveyor and adjustment features for raising and lowering the conveyor and sewing head.—*Union Special Machine Co.*

Drum Filler
Solves Foaming Problem

(182B) A new drum filler developed by the Socony-Vacuum Oil Co. will soon be offered as a commercial item. The new device permits fast filling rates, yet avoids the formation of surface foam.

In speeding up operation of a drum-filling line, Socony found that foam build-up limited the rate of filling. At the desired rate, which was one drum every 45 sec., foam build-up was sufficient to limit the capacity of a 55-gal. drum to 54 gal., and when filling speed was decreased to allow filling to 55 gal., drum throughput was reduced by one-third.

The new device operates on the principle of sub-surface filling. Filling starts with the nozzle extended into the drum almost to the bottom. After approximately 60 lb. of oil is in the drum, the tip of the nozzle is submerged and a mechanism automatically begins to withdraw the nozzle upward at a predetermined rate, maintaining it just below the surface. The rate of rise is determined experimentally and depends upon filling speed. When the drum is full, the flow is automatically cut off. The automatic mechanisms are actuated by limit switches on the weighing scale.—*Toledo Scale Co.*

Filling Scale
Bags Bulk Materials

(182C) Bulk materials such as chemicals, plastics and fertilizers now can be automatically net-weighed and bagged by the new Model 400N filling scale at speeds up to 12 per min. for 50-lb. bags and 10 per min. for 100-lb. bags. Performance is guaranteed to be accurate to 0.1 lb. for any desired weight from 25 to 200 lb.

Based upon the same principles as the Model 400 scale (see *Chem. Eng.*, Jan. 1952, p. 186), the 400N is equipped with a self-gripping bag holder, an automatic net-weighing hopper, a supply tube whose opening may be varied up to 72 sq. in., an air-operated feeding gate and an automatic check-weighing and bag-releasing system.

The feeding system utilizes both gravity and vibration. Close control of the amount and speed of feed make it possible to load any free-flowing material without packing, aerating, separating or otherwise altering the material's physical characteristics, it is claimed. An adjustable flood-proof gate partially closes when the hopper is filled to about 95 percent of the desired weight. The material is then dribble-fed by means of vibration until full weight is reached.

The moment the desired weight is reached, the gate closes to a tight seal and lights indicate whether the load is underweight, the proper weight or overweight. If the weight is within the preset tolerance, the charge is automatically dumped into a self-gripped cotton, jute or paper bag and the filled bag is automatically released. —*Thayer Scale & Engineering Corp.*

Remote Control Attachment
For Fork Trucks

(182D) A new attachment for fork trucks allows you to control the lifting and lowering action of the forks at a distance from the truck's control panel. It was originally developed for a manufacturer who wanted a way to get at infrequently used stock stored in hard-to-reach bins.

Lifting and lowering is controlled by the small remote control unit held in the operator's hand. During normal truck operation this unit clamps over the tie bar on the truck's inner upright.—*Baker-Raulang Co.*

Packaging & Handling Briefs

Drum Cradle—Facilitates horizontal tiering, using fork trucks, of wooden barrels and steel drums. Made of oak. McKinney Wood Products Co. *(182E)*

Vibrator Clamp—Air-operated, speeds up attachment of external vibrators to load. Viber Co. *(182F)*

Bin Vibrator—New 5-in. size for heavy duty. Air-cushioned operation eliminates metal-to-metal pounding for quiet operation. Cannon Vibrator Co. *(182G)*

Bin Vibrator—Model DV 51 gives a powerful all-directional vibration for large hoppers and bins. Martin Engineering Co. *(182H)*

Elevating Conveyor—New Robo-Lift has capacity of 25 cu. ft. per min. of solids. Counsel Machine Co., Inc. *(182I)*

Skid Adapter—Enables conventional hand pallet trucks to lift and handle skid platforms. Raymond Corp. *(182J)*

Lift Truck Attachments—Permits carrying two or four drums at a time. Hyster Co. *(182K)*

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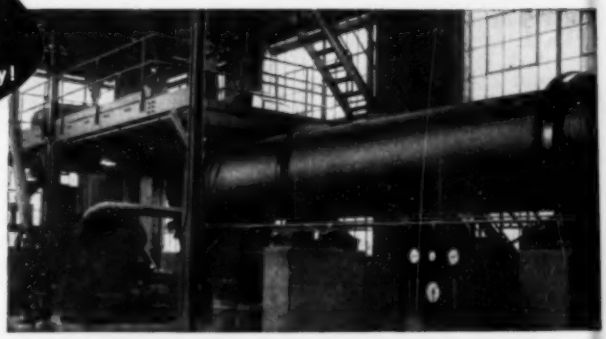


FORMER DRYER

Installed cost	$40,000
Annual production (tons)	6,000
Drying cost per ton	3.72
(space required, 1500 sq. ft.)	

LOUISVILLE DRYER

Installed cost	$20,000
Annual production (tons)	9,000
Drying cost per ton	0.83
(space required, 500 sq. ft.)	

YEARLY SAVINGS of LOUISVILLE DRYER in OPERATING COSTS ALONE $14,850

A magician's creation? No! The Louisville Dryer described here was installed by a chemical processor after his production was completely analyzed by a Louisville engineer. By using advanced, complete knowledge of drying processes, this dryer was especially designed to fit into his production line after the dryer's performance was pre-determined in our own unique research laboratories and pilot plant.

Without obligation ask a Louisville engineer to survey your drying methods. He may come up with a better solution that costs you less for faster, more satisfactory production.

Other General American Equipment:
Turbo-Mixers, Evaporators, Dewaterers, Towers, Tanks, Bins, Filters, Pressure Vessels

PROCESS EQUIPMENT DIVISION GENERAL AMERICAN TRADE MARK

Louisville Drying Machinery Unit
Over 50 years of creative drying engineering
GENERAL AMERICAN TRANSPORTATION CORPORATION
Dryer Sales Office: Hoffman Bldg., 139 So. Fourth Street Louisville 2, Kentucky
General Offices: 135 South La Salle Street, Chicago 90, Illinois
Offices in all principal cities
In Canada: Canadian Locomotive Company, Ltd., Kingston, Ontario

Hydrocarbon Detector Measures Toxic Vapors

(184A) A new portable device for measuring concentration of aromatic hydrocarbon vapors helps to protect workers against excessive exposure to toxic atmospheres. All you do to make a test is squeeze the aspirator bulb three times. Concentration of vapor is indicated by length of stain in a detector tube. Tubes can be filled with the detecting reagent in the field as needed.

Scale of the detector tube is calibrated separately for benzene, toluene and xylene. This feature is useful, because maximum allowable concentrations for 8-hr. per day exposure are different for the various aromatics.

Price of the detector, including leather carrying case, is $45. Chemicals and tubes for 12 tests cost another $5.—*Mine Safety Appliances Co*

Automatic CO_2 Systems In Packaged Units

(184C) Packaged automatic carbon dioxide systems are now available for protection of industrial areas up to 6,000 cu. ft. against flammable liquid hazards. Chief advantage of the packaged units, as far as the user is concerned, is the savings in cost over custom-built installations.

For many years this manufacturer has produced packaged systems for yachts and smaller boats. Recognizing the need for similar facilities suitable for industrial use, the company has developed the new Standard Pak systems.

These systems come in six sizes, depending upon the amount of space to be protected. The smallest size uses one 50-lb. CO_2 cylinder; the largest uses a supply of 300 lb. of CO_2 in a bank of four 75-lb. cylinders. Each package contains temperature rate-of-rise fire detectors and connector tubing, automatic control heads, discharge heads, Multijet nozzles and a cylinder supporting frame. Cylinders are shipped as separate items. The systems may be ordered with or without pipe and fittings.

Among the accessory items available are remote control pull-boxes for manually actuating the system from locations other than at the cylinders and pressure-operated trips that can automatically close weight-operated doors and windows when the system discharges. Provision can also be made for shutting down ventilation and machinery via pressure-operated switches.—*Walter Kidde & Co.*

Fog Nozzle Works From Garden Hose

(184D) The New Triple Jet safety nozzle is designed to deliver a fine pattern of protective fog, even with low-pressure water supplies. Made with 3/4-in. threads for connection to ordinary garden hose, it eliminates the danger of a straight stream of water when combating flammable liquid fires. It delivers approximately 2½ gpm. when supplied with water at 50 psi.—*Fogg-It Sales Co.*

Fog Nozzle Reaches to 80 Ft.

(184E) A new fog nozzle, made with standard 2½-in. thread connection, delivers a 500-gpm. fog blanket with an effective reach of 80 ft., according to the manufacturer. It is claimed that the cooling effect of this large volume of fog will quickly extinguish large flammable liquid fires as well as wood, paint and other types of fires.

Designated as the Giant Model 500, this nozzle uses a spiral atomizing element in which small orifices and internal parts are absent. Small solid particles can thus pass freely through the nozzle without clogging.—*Bete Fog Nozzle Inc.*

Four New Respirators For Dusts and Fumes

(184F) A new line of four respirators offers improved comfort and service, according to a recent announcement. Two of them protect against fumes, the other pair guard against dusts.

The MSC and MSE are cartridge types, useful in atmospheres containing low concentrations of benzene, toluene, gasoline, acetone and similar vapors. The MSD and MSF respirators employ specially treated felt filters for use in dusty atmospheres.—*DeVilbiss Co.*

DYNEL COVERS PROTECT AGAINST LEAKAGE

(184B) These new valve and flange covers, made of dynel, are designed to provide protection against leakage without hindering normal operation. They are said to cost only one-third as much as conventional lead covers and can be easily installed without special tools.—Mine Safety Appliances Co.

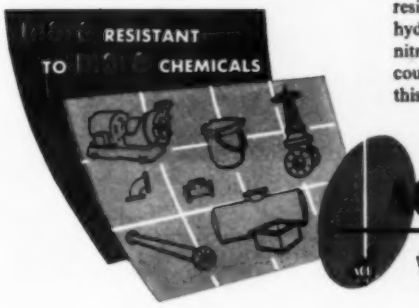
"SPEED-O-PLATE" agitator

...USES ACE® hard rubber THROUGHOUT

FOR HANDLING FLUOBORATES

By rapidly removing spent plating solution from the surface being plated, and continuously replacing it with live, up-to-formula solution, this impressive "Speed-O-Plate" Agitator makes it possible to plate smooth, heavy, lead coatings at extremely high current densities with maximum brightness — in some cases speeding up the work by 75% or more.

For corrosion resistance and mechanical strength, Alsop Engineering Corp. makes it entirely of ACE hard rubber. The piping is standard ACE hard rubber. The 8" blocks are made in halves from ACE sheet. The spray heads are molded by ACE. Holes are drilled. Even the motor coupling is insulated with hard rubber, and the shaft is covered with ACE tubing.



In all types of chemical equipment, ACE hard rubber resists all alkalis, metallic salts, inorganic acids, hydrochloric acid any strength, sulphuric acid to 50%, nitric acid to 20%, phosphoric acid to 75%, and countless other corrosives. Other ACE plastics extend this range still further. Ask for new ACE catalogs.

ACE rubber and plastics products

AMERICAN HARD RUBBER COMPANY
93 WORTH STREET • NEW YORK 13, N. Y.

Steam Trap Has Built-In Bypass

(186A) Two special valves incorporated in the Universal steam trap now provide for bypassing whenever it is necessary to blow down the condensate line. This arrangement occupies less space than would be required with three separate valves plus a steam trap and, it is claimed, will cost much less.

The new trap uses a color signaling device to indicate the position of the bypass valves. The complete unit weighs only 16 lb. and combines trap with air vent, check valve, control glass and bypass. It can be installed in any position and can handle pressures up to 350 psi.—*Velan Engineering Co.*

Portable Electric Heater Speeds Winter Operations

(186B) The problem of keeping men warm and working in hard-to-heat locations both indoors and out is being solved in many cases with a recently developed Chromalox electric radiant comfort heater. Although admittedly costly by the usual standards, these heaters often save more than they cost in lost time and interrupted production.

Typical outdoor operations using these heaters include truck and boxcar loading, receiving and shipping desk work, watchmen's houses and maintenance jobs. The unit illustrated is used inside a boxcar; it helps keep freight moving in coldest weather.

Three models are available. One is 24½ in. long, rated at 800 watts; another is 30¾ in., 1,100 watts; the third is 46¾ in., 1,800 watts. The first two can be obtained in 115 and 230 v., while the latter is for 230 v. only. Protective grills and input controllers for selective heating are optional.—*E. L. Wiegand Co.*

Electric Heaters Of Improved Design

(186C) The Chromalox Type TBL electric tank heater now is provided with a vapor-tight terminal box. Heavy-duty heating elements are welded to a sealed electrical connection housing, and the wiring is brought out to a terminal box through a thick-walled steel pipe. This construction makes the heater more suitable for uses involving the presence of corrosive and penetrating vapors. Ratings of 3 to 7½ kw. are available.

Another Chromalox heater, Type ARMT (not illustrated), is now available with wider built-in thermostatic range. With brass or copper construction for water heating, the range is from 50 to 250 deg. F.; with steel for oil heating, it is 150 to 550 deg. This unit is an explosion-proof screw-plug type. It is made in ratings from 1½ to 10 kw. and heated lengths from 8 to 48 in.—*E. L. Wiegand Co.*

Tube Cleaner For Small Straight Tubes

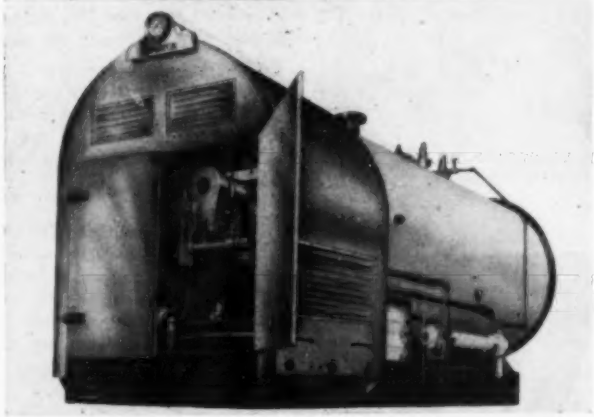
(186E) A new line of suspension type tube cleaners is especially designed for cleaning small straight tubes and, with the proper selection of cleaning tools, these cleaners are equally efficient in removing either hard or soft deposits, according to a recent announcement.

One of the improvements over previous cleaners is in the control system. The control valve is actuated by a trigger located at the base of one of the operating handles. The trigger is convenient to your right hand but not in a position to be opened accidentally. It actuates a simple throttle valve which can be regulated continuously from wide open to shut-off. When you release the trigger, the valve opens and the motor stops.

This trigger also controls the flow of water for cooling the drills and flushing out the loosened scale. The water feeding mechanism features a new self-adjusting packing which can be changed to handle either water or solvent, as the application demands.

An improved heavy-duty electric motor, with trigger-controlled valve and built-in water feeding attachment, is also available for use where a supply of compressed air is not on hand.

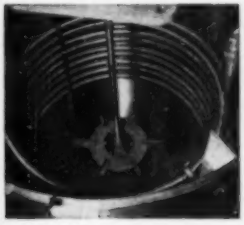
Two new drill heads have been designed for soft, gummy deposits, where strong flushing action is required, or for very hard deposits.—*Elliott Co.*



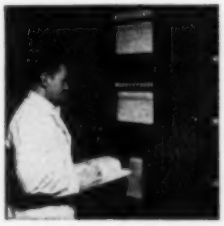
STEAM GENERATOR IS IN THE DOG-HOUSE

(186D) **A special housing has been designed to protect the working parts of steam generators installed outdoors. Although simple, the construction is said to be watertight. Safety features include power lockouts to prevent operation with the doors closed when someone is in the enclosure.–Superior Combustion Industries, Inc.**

MEASURING POWER CONSUMPTION of mixer impeller. Mixer shaft is fitted with electronic torquemeter. Power consumption is recorded continuously on a strip chart, as part of data required for accurate sizing.



TEST TANK is fitted with dual-wound helical coils that permit steady-state temperature conditions while testing. Thermocouples in coil walls record data on point conditions.



RECORDING POTENTIOMETER automatically plots temperature data from thermocouples, on as many as 32 stations, one every 3 seconds, for accurate calculation of heat transfer coefficients.

HIGH-EFFICIENCY HEAT TRANSFER IN TANKS

How to get *guaranteed* results, minimum heating-cooling time, and accurate process control

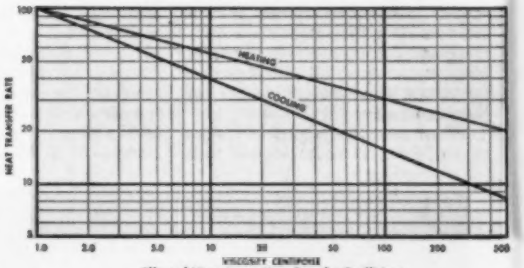
On any project involving heat transfer in kettles or tanks, check first with Mixco engineers. Their experience can help you arrive at:

- *most efficient heating and cooling equipment (vertical tubes, helical coils, etc.)*
- *correctly sized mixer for exact temperature control*
- *accurate prediction of heating-cooling time*
- *fully guaranteed results*

The answers on high-efficiency heat transfer are at your disposal, without cost or obligation. Facts are derived from hundreds of successful heat transfer installations using LIGHTNIN Mixers, plus constant research with up-to-date laboratory and pilot equipment.

For more details, call your LIGHTNIN Mixer representative. Or write us today, briefly describing your needs. For catalog information on LIGHTNIN Mixers, check and mail the coupon.

Research is key to good heat transfer



Effect of Viscosity on Heat Transfer Coefficient

Graph shows the effect of viscosity on heat transfer coefficient. Similar data on flow rate, vessel size and shape, impeller size, shape, location and other variables enable MIXCO Engineers to accurately specify heat transfer conditions for your particular process.

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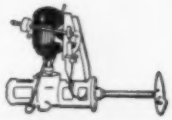

SIDE ENTERING
1 to 25 HP

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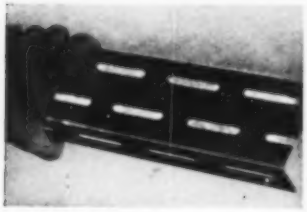


Slotted Angle For Fast Construction

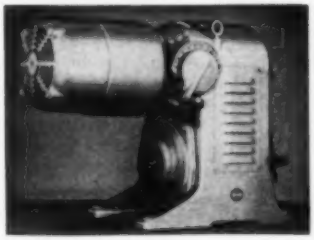
(188A) Resembling an Erector set on an industrial scale, the Dexangle permits the rapid erection of scaffolds, partitions, motor and machinery mounts, trays, handrails, etc. Although widely used in England, Canada and Australia under the trade name Dexion, this useful structural shape is just now being introduced in this country.

Hacksaw and wrench are the only tools you need for assembly. However, the cutting operation goes faster if you have a special one-stroke shear cutter. No special brackets, braces, clips or hooks are required. Drilling and welding are unnecessary.

Dexangle comes in 10-ft. lengths. Widths of the legs are 3 in. and 1½ in.; thickness is 0.08 in. Diamond shaped indentations spaced at 3-in. intervals along the length make measuring and cutting a simple operation. Slots are automatically in alignment for bolting when you cut pieces along these indentations.

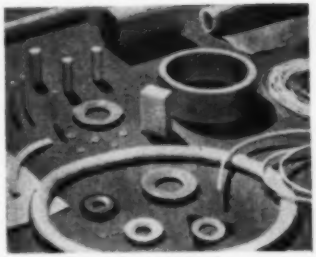
When used as uprights in lengths up to 5½ ft., these angles will individually support loads up to 1,200 lb. Longer lengths require bracing or assembly as composite sections. When used horizontally, concentrated loads from 90 to 3,800 lb. are permissible, depending upon the distance between supports and the section used. Evenly distributing the load doubles the safe rating.

Dexangle is sold by the package. Each package contains ten 10-ft. lengths of angle and 75 bolts and nuts. —*Acme Steel Co.*



Variable Speed Drive Is Explosion-Proof

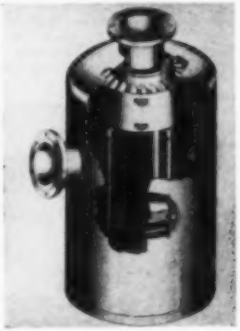
(188C) A completely self-contained variable speed motor-drive is now available in an explosion-proof model. This unit saves space and eliminates the intermediate connections required when using an explosion-proof motor with a separate speed changer, the conventional method of achieving the same result. The drive is available in output speeds from 2 to 10,000 rpm., in ratings from 1 to 20 hp.—*U. S. Electrical Motors Inc.*



Gaskets and Packing Made of Teflon

(188D) A complete line of Teflon gaskets and packing, as well as Teflon sheet, tape, cylinder, rod, tube, bar stock and special machined shapes, has recently been announced.

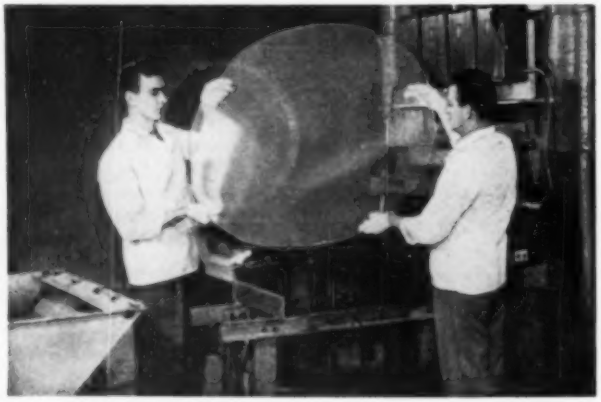
Packing is furnished lubricated or unlubricated in endless rings and in continuous braided construction. Braided types are available with blue asbestos core. Gaskets are supplied in jacketed construction, with a choice of insert materials, or as solid shapes. —*Flexrock Co.*



Vapor Purifier Removes Unwanted Entrainment

(188E) A new purifier for removing entrainment from steam, compressed air and other gases and vapors is supplied in the form of a receiver or drum with the purifier installed inside. Suggested applications for this unit are the protection of steam engines and turbines, removing oil from exhaust steam, and removing condensate from compressed air systems.

The device uses no moving parts, depending entirely upon changes in velocity and direction of flow of the vapor for its cleaning action. In steam installations the unit is guaranteed to deliver steam containing less than 0.5 ppm. of solids from a steam supply containing as much as 1,000 ppm. of solids. For exhaust steam, the guar-



LARGE SOLID KEL-F GASKET

(188B) One of 600 gaskets destined for a large chemical plant, this 45-in. solid Kel-F disk is ¼-in. thick and weighs 16 lb. Kel-F is a highly resistant fluorine-containing resin.—United States Gasket Co.

antee specifies less than 2.5 ppm. of oil.

Receivers conform to ASME requirements for unfired pressure vessels. Units are made in nominal sizes of from 4 to 16 in., corresponding to the diameter of the pipe connections. Actual drum diameters run from 24 to 42 in.—*V. D. Anderson Co.*

Molded Packing Ring Is Self-Centering

(189A) Uneepac is a new automatic ring packing designed for maximum sealing efficiency in minimum packing depth. Here are some of the advantages claimed for it by the manufacturer:

1. High sealing efficiency permits use of smaller stuffing boxes.
2. No follower or header rings are needed.
3. Each ring centers itself perfectly on the preceding ring.
4. Each lip is always exposed to fluid pressure, making sealing independent of gland pressure and thus reducing friction and wear.

Uneepac is offered in varied compositions to suit different services. It is furnished in sets of endless or split rings and is available for shafts of ⅜-in. dia. and up.—*Johns-Manville Corp.*

Electrical & Mechanical Briefs

Interval Timer—Times and tabulates individual steps in an over-all operation. As many as 15 separate steps are automatically registered at each setting. Zenith Electric Co. *(189B)*

Rotating Limit Switch—Model R-1000-A, controls the travel of any rotating device requiring interruption or establishment of electrical current after a predetermined number of revolutions. Crane Electric Co. *(189C)*

Automatic Lubricator—Gives wheels of trolley conveyors a shot of grease each time they go by. J. N. Fauver Co. *(189D)*

Outdoor Motor Controls—Units consist of a combination across-the-line starter with circuit breaker in a rain-tight enclosure, with a built-in pushbutton or selector switch. Westinghouse Electric Corp. *(189E)*

Gearmotor—Type GM Syncrogear available in 1 to 10 hp. with speed ranges of 5 to 25 rpm. Two secondary pinions provide high torque; triple reduction gearing offers speed ratios up to 175:1. U. S. Electrical Motors, Inc. *(189F)*

FOR SKILLED PERFORMANCE BY UNSKILLED OPERATORS

INDOORS and OUTDOORS YOUR *BEST* PROTECTION FOR FLAMMABLE LIQUID, GAS AND ELECTRICAL FIRES

Textile Lint Fires

ANSUL DRY CHEMICAL FIRE EXTINGUISHING EQUIPMENT

Flammable Liquid Fires

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HAND PORTABLES • WHEELED PORTABLES • STATIONARY EXTINGUISHERS AND PIPED SYSTEMS • TRUCK MOUNTS, TRAILERS AND SELF-PROPELLED UNITS •

Ansul Dry Chemical Fire Extinguishing Equipment has world-wide recognition as preferred protection for flammable liquid, gas and electrical hazards. Yet a surprising number of Ansul Extinguishers are used to protect textile mills and paper mills against serious loss from surface fires such as occur in textile lint and combustible paper dust.

The textile and paper making industries rely on Ansul Extinguishers for quick control of dangerous flash fires in class "A" (ordinary combustible) materials. Any remaining embers are quenched with small quantities of water, thereby keeping water damage at a minimum.

Surface fires in textile lint and combustible dusts spread rapidly. They need quick control. If you have serious lint or dust hazards, talk with your Ansul representative. He may have suggestions to reduce fire damage and lost production time.

ANSUL MODEL 20-B

Send for File No. 934. You will receive a variety of helpful printed matter. Included is our latest catalog which describes Ansul Extinguishers of all sizes — from the small Ansul Model 4 to Ansul Piped systems and Ansul 2000 lb. Stationary Units.

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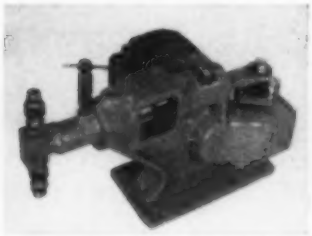
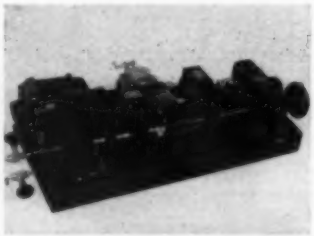




ADJUST-O-FEEDER (left) and Micro-Feeder pump at constant volumetric rates.

New Metering Pumps

Five recent developments in constant-delivery pumps and proportioning equipment broaden the line offered by Proportioneers, well known specialists in this field.

(190A) Although a happy choice of corporate name may have contributed to the close association in the minds of most chemical engineers of Proportioneers, Inc., with metering and proportioning equipment, the company is not depending on its name alone to maintain a leading position in this field.

Typical of this activity is the recent announcement of five new developments, covering both constant-delivery and proportioning applications and operating on gravimetric as well as volumetric principles.

Model X52 Adjust-O-Feeder—This pump is designed for constant-rate volumetric feeding of treating chemicals, such as boiler compounds, inhibitors, dyes and emulsion breakers, where a low-capacity, medium-pressure pump will do the job.

The standard size has a capacity range of 1 to 10 gal. per hr. and will discharge against pressures up to 650 psi. For lower feed rates, another unit is available with a range of ¼ to 5 gal. per hr. Only one cylinder-and-plunger assembly is required for the two rates of feed, as the pump can be provided with two worm gear ratios to stroke at either 43 or 86 strokes per min. Plunger diameter is ½ in. and stroke length is 1¼ in.

Volumetric accuracy is guaranteed from maximum down to 10 percent of maximum displacement within 1.5 percent error.

Model HP-VS Micro Feeder—This device is a single-stroke pump for feeding a liquid at a slow rate with a high degree of precision and uniformity. Developed especially for laboratory and pilot plant work, it gives a smooth feed at rates of 0.1 to 10 cc. per hr. against pressures up to 2,000 psi.

The Micro Feeder consists of a measuring cylinder assembly mounted horizontally in a cast iron frame and secured to a steel baseplate. A plunger coupled to a feed screw is driven into the cylinder at a controlled rate. With close temperature control, the weight rate of pumping is said to be reproducible within ¼ of 1 percent.

Weight-O-Matic Scale—Here is a unit operating on gravimetric principles, for feeding chemicals by weight either at constant rate or in response to process variables. Rate of feed is infinitely adjustable, from a few ounces to many pounds per min. Feed may be injected into vacuum or pressure without affecting performance, it is claimed.

Model MDC-3 Continuous Automatic Blender—This volumetric proportioner can be used for blending two components over a ratio range of 10/90 to 90/10. Changes in rate can be made by a single adjustment without affecting the preset proportions.

Chlor-O-Mite—Provided with a transparent plastic reagent head, this device feeds small quantities of water-treating chemicals, such as hypochlorite, aqua ammonia, fluorides and dilute acids. Capacity is adjustable while operating to a maximum of 2 cc. per stroke, with stroking rates up to 60 per min. against pressures up to 50 psi.—%Proportioneers, Inc.%

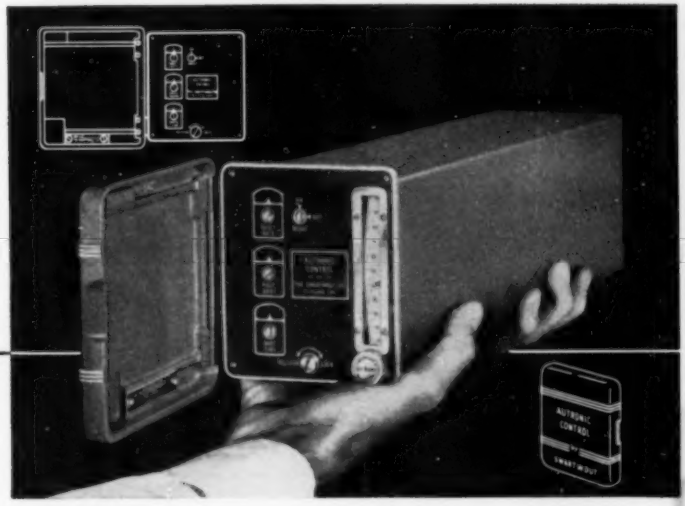
Ammonia Compressor For Unloading Cars

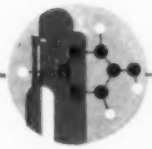
(190C) A new compressor unit for transferring ammonia from tank car to storage tank not only transfers liquid ammonia but also recovers the residual vapors left in the car after it is emptied of liquid. These residual vapors, amounting to 800 to 1,200 gal., are often left in the car.

The transfer unit comprises compressor, motor, starting switch, suction surge drum, oil filler pot, combined

AIRFOIL BLADES IMPROVE CENTRIFUGAL FAN EFFICIENCY

(190B) **This group of engineers is making a performance test on a scale model of a new centrifugal fan wheel with airfoil blading. The tests demonstrated a mechanical efficiency for airfoil blading of 92 percent, compared with 84 percent for conventional bladed fans. In addition, the new fan is said to be quieter, developing 65 percent less noise energy.–Westinghouse Electric Corp., Sturtevant Div.**





accurate . . . instantaneous

all-electronic instrumentation

• No matter how fast a pneumatic or electro-mechanical control system may function, it cannot compare with the *instantaneous, all-electronic response of the Swartwout Autronic Control System.*

Heart of the system is the compact, plug-in type Autronic Controller. All-electronic operation means it has no mechanical motion whatsoever . . . no slide wires, boosters or motors to initiate control action . . . no air lines from the measuring element or to the final element. Hence the Autronic Controller eliminates all transmission lags . . . spans distance between primary and final elements *without interval.* Accurate, positive calibration gives the Autronic Controller complete interchangeability . . . eliminates any need for recalibrating, adjusting or trimming.

Call in our engineering representative to explain how the Autronic Control System can bring new accuracy to your process or power instrumentation. Or write *today* for literature on the new Swartwout Autronic Control System. A-701•

Swartwout *Autronic* CONTROL SYSTEM

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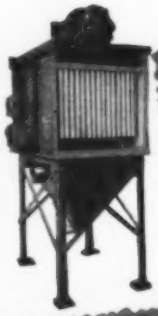
BLAST CLEANING!

Blast Cleaning Cabinet quickly and easily cleans rust, grime, dirt, paint, etc., from metal parts. Produces a clean, smooth surface on pieces up to 60" x 36". Models available from $319.00 and up.

Blast Cleaning Machine not only removes rust, dirt, scale, etc., but is ideal for maintenance and many other uses. Cleans large objects such as bridges, structural work, tanks before painting. Six sizes, portable or stationary, from $170.00 and up.

DUST COLLECTING!



Unit Dust Collector stops dust at its source, minimizes machine wear and tear, reduces housekeeping and general maintenance costs. Solves many grinding and polishing nuisances. Reduces material losses. Models from $286.00 and up.

PRECISION FINISHING!

Hydro-Finish Cabinet uses liquid blast, eliminating dust, and reduces costly hand polishing, cleaning and finishing of molds, dies, tools, etc. Removes scale, discoloration and directional grinding lines, prepares surfaces for plating and coating. Holds tolerances to .0001". Models from $1410.00 and up.

LOOK TO PANGBORN FOR THE LATEST DEVELOPMENTS IN BLAST CLEANING AND DUST CONTROL EQUIPMENT

Pangborn

MAIL COUPON for full details

(Check for more information)

- ☐ Blast Cleaning Cabinets
- ☐ Blast Cleaning Machines
- ☐ Unit Dust Collectors
- ☐ Hydro-Finish Cabinets

PANGBORN CORP., 2600 Pangborn Blvd., Hagerstown, Md.

Gentlemen: Please send me more information on the equipment I've checked at the left.

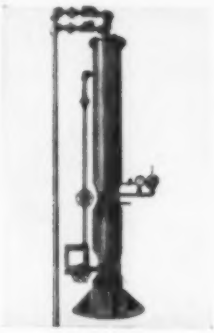
Name.....

Company.....

Address.....

City.....Zone.....State.....

discharge drum with relief valve and oil separator with automatic return, drive, guard and base.—*Worthington Pump & Machinery Corp.*



Mercury Piston Pump For Corrosive Liquids

(192A) The Merc-O-Pump is a new device for pumping corrosive liquids with a controlled rate. It is operated by compressed air, with a column of mercury acting as a fluid piston interposed between the air and the liquid pumped.

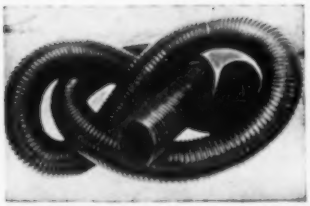
Discharge rate is controlled by setting the rate of air supply, and can be varied from 3 to 30 gal. per hr. Although not intended to be a precision metering pump, delivery over a long period will average fairly close to the preset rate.

Although pumping action is cyclic, no timing arrangement is needed. The frequency of the pump stroke is directly dependent on the amount of air pressure supplied, with the duration of suction and discharge strokes inherently controlled by the position of a steel float riding in the mercury column and periodically actuating a vent valve.

Outer dimensions are 1½ in. dia. by about 30 in. long. A wide variety of materials can be used for the parts in contact with the pumped liquid. Prices range upwards from $100 for steel.—*Instruments, Inc.*

Flexible Metal Hose Gives Longer Life

(192B) Uniflex is a new flexible seamless bronze hose developed for severe services. A special method of fabrication is said to distribute the flexing between the inner and outer convolutions, thus allowing greater flexibility and longer life. For additional safety, Uniflex can be provided with a covering of one or more layers of bronze wire braid.—*Titeflex, Inc.*



Flexible Hose Of Nylon and Neoprene

(193A) A new lightweight flexible hose is made of neoprene compounds and laminated nylon chafer duck. Wire reinforcing makes the hose suitable for pressure and vacuum services. Diameters range from 1¼ to 24 in.—*American Ventilating Hose Co.*

Air Compressors As Self-Contained Units

(193B) Announcement has been made of a new line of small air compressors which are furnished as complete self-contained compressed air systems. Sizes range from ½ to 5 hp., in single and two-stage models.

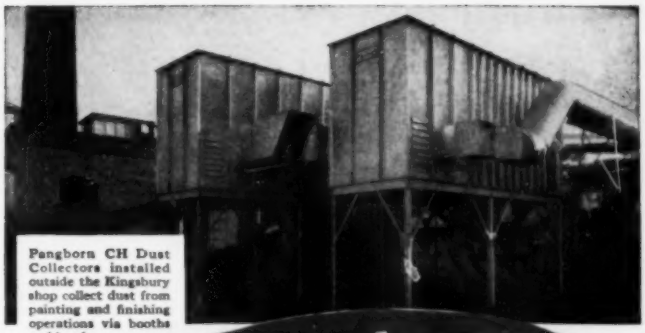
The unit illustrated includes safety and outlet valves, pressure gage and switch, intake muffler, fan-bladed flywheel, air filter and V-belt drive.—*Schramm Inc.*

Fluids Handling Briefs

Exhaust Fan—Mounts in duct with motor outside of air stream. In sizes from 16 to 36 in.; air deliveries to 23,000 cfm. Chelsea Fan & Blower Co. *(193C)*

Tank Car Fitting—Designed for one-man operation. Incorporates a plug valve with adjustable clearance for handling hot materials. Mead Cornell & Co. *(193D)*

Roof Ventilator—Mechanically actuated louvers open fully and automatically when fan is started. Sizes up to 45,000 cfm. Tripar Products, Inc. *(193E)*



Pangborn CH Dust Collectors installed outside the Kingsbury shop collect dust from painting and finishing operations via booths and hoods.

One Pangborn Installation Solves 6 Dust Control Problems!*

Hoods exhaust dust from hand polishing and grinding booths to outside Collectors

FINISHING operations at Kingsbury Machine Tool Corporation presented a 6-fold dust control problem to Pangborn engineers. Several priming, lacquering and spray painting operations had to be protected from dust created in other finishing jobs such as snagging, grinding and smoothing.

To control these dusts efficiently, Pangborn recommended booths, tables and exhaust hoods. Four main booths, four snagging tables, one snagging bench and a bench grinder hood control the dust at the source. All these are exhausted to two CH Collectors located out-of-doors.

Kingsbury reports the complete system "highly satisfactory"—with these added benefits: Heating costs have been lowered substantially through recirculation of the cleaned air. Costly dust damage to adjacent machinery and products has been prevented. And workers' efficiency has increased due to cleaner working conditions.

What are your Dust Problems? Find out what Pangborn can do to solve them. Write today for Bulletin 909A. Address: PANGBORN CORPORATION, 2600 Pangborn Blvd., Hagerstown, Md.

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment

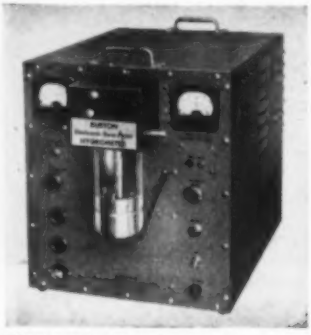
Pangborn DUST CONTROL

STOPS THE DUST HOG from stealing profits

Portable Calculator Gives Five Decimal Places

(194A) Combining the portability of a slide rule with the speed and accuracy of a large desk calculator, this device will add, subtract, multiply, divide, figure square roots, factors, cubes and percentages. It carries to five decimal places and totals to 99 billion. Made by Swiss watchmakers, it weighs only 8 oz.

Price of $129 includes a rubber-lined metal case.—*Curta Calculator Co.*



Electronic Hygrometer Measures Dew Point

(194B) This new hygrometer will continuously indicate the temperature at which any component of a gas will form a dew. In addition, it can continuously indicate or control the concentration of any component whose phase change will fog a cold surface.

It consists of a polished metal mirror and an associated electronic servo loop to maintain the mirror at dew point temperature. The temperature can be anywhere within reach of a liquid air bath, although the usual source of cold is dry ice and alcohol. The instrument was originally developed in connection with meteorological research on the upper atmosphere.

To operate the instrument, you connect a tube conveying the gas sample to the mirror chamber and thermocouple leads from the terminals on the panel board to a separate recording potentiometer. The instrument feeds high frequency heating current modulated by a photocell to the mirror (only 0.002 in. thick) so as to hold the mirror temperature within 0.1 deg. C. of the dew point. A thermocouple fixed to the back of the mirror delivers the output to the panel board terminals.

The unit is enclosed in a steel cabinet, approximately 14 by 16 by 18 in. All controls and connections are on the front panel.—*Burton Mfg. Co.*

Multi-Tube Cable For Instrument Lines

(194C) Instrument control circuits can now be streamlined through the use of Armortube cable, a flexible, protected multi-tube transmission line. This cable is made up of ¼-in. O.D. aluminum or copper tubes gathered in a slow, continuous rope-like spiral. The tube bundle is first wrapped in water-repellent insulating tape, then encased in heavy galvanized steel strip, resembling BX electrical cable.

Advantages of Armortube are savings in installation time and costs, protection of instrument lines against corrosion and damage, conservation of space and improvement of plant appearance. Expensive support racks are eliminated—standard pipe or conduit clips may be used to fasten Armortube cable to walls or ceilings.

Armortube is available in bundles of 4, 8 and 12 tubes. A tracer tube easily identifies corresponding tube ends between cable connecting points, since all tubes in a bundle maintain the same relative positions. Connections and take-offs may be made in standard electrical junction boxes.

The cable is shipped in random lengths of approximately 500 ft. on returnable reels. You use only what you need, store the rest for the future. —*Bailey Meter Co.*

Shaft-Position Indicator Has Digital Output

(194D) A new shaft-position indicator rapidly and accurately detects the angular position of a rotating shaft and converts the result into a digital representation.

Designated as the Shaft-Monitor, the new device consists of two major components, an electromechanical locator unit and an electronic converter unit. It uses a simple magnetic recording mechanism to indicate on command (as often as 20 times per sec.) the position of a reference shaft. It is said to be accurate to 0.09 deg.—*Engineering Research Associates.*

Pressure Controller Is Easily Adjusted

(194E) A new compact non-indicating pressure controller features an accurate, easily operated set-point adjustment. In addition, control action may be changed from direct to reverse in a matter of seconds.

The new device may be mounted directly on the control valve or on a wall or panelboard.—*Minneapolis-Honeywell Regulator Co.*

Operator's Desk Centralizes Controls

(194F) You can now read up to 96 different temperatures in about as many seconds without even leaving your post behind a new console control desk. This eliminates the constant walking and logging from one

EQUIPMENT NEWS, cont. . .

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

Dowell Service restored original capacity IN ONE DAY!

A fractionating bubble-cap tower, operated by a southern chemical company, contained heavy deposits of iron sulfides, oxides and organic material. These deposits covered the trays and clogged the bubble-caps reducing capacity from 800 to 500 gallons per minute. *Fast, efficient* Dowell Service cleaned this tower in one day. Result: tower was restored to its original 800 g.p.m. capacity.

Dowell Service methods can be applied to many different kinds of refinery and chemical equipment *without dismantling and with a minimum of downtime!* Special liquid solvents designed to dissolve and disintegrate the deposits are pumped or sprayed into the equipment. No special scaffolding is required. Specially designed truck-mounted tanks, pumps, heaters, mixers and control equipment necessary to do the job properly are brought right into your plant.

What is *your* cleaning problem? Dowell Service has extensive experience in cleaning towers, cooling systems, heat exchangers, steam generating equipment, condensers, pipe lines, cooling jackets and many other types of industrial equipment. Call upon Dowell experience and equipment to help increase production. Dowell engineers will be glad to give FREE consultation. Phone the nearest Dowell office.

Other recent Dowell jobs:

All exchangers and towers in a southwestern chemical plant were cleaned by Dowell Service during a complete plant turnaround. Result: Plant turnaround time was cut from fifteen to six days.

•

Over 11,000 feet of 10 to 16-inch diameter fresh water service lines in an oil refinery were cleaned by Dowell Service. Result: Water lines were restored to designed capacity.

•

The Slurry-to-Feed heat exchangers in a fluid catalytic cracker were Dowell Serviced. Result: Company was able to increase through-put from 16,000 to 22,000 bbls. per day.

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

CALL

New York 20	Pittsburgh 19	Ft. Worth 2	Mt. Pleasant, Mich.
Boston 16	Detroit 2	Shreveport 69	Hamilton, Ohio
Philadelphia 2	Chicago 4	Atlanta	Charleston, W. Va.
Baltimore	St. Louis 8	Indianapolis	Salem, Illinois
Wilmington 99	Kansas City 8	Louisville	Beaumont, Texas
Richmond 19	Wichita 2	Upper Montclair, N. J.	Borger, Texas
Jacksonville 2	Oklahoma City 2	Anniston, Alabama	Midland, Texas
Buffalo 2	Houston 2	Hattiesburg, Miss.	Wichita Falls, Texas
Cleveland 13	New Orleans 12	Lafayette, La.	Hobbs, N. Mex.

★ *Maintenance cleaning service for industrial heat exchange equipment.*
★ *Chemical services for oil, gas and water wells.*

DOWELL

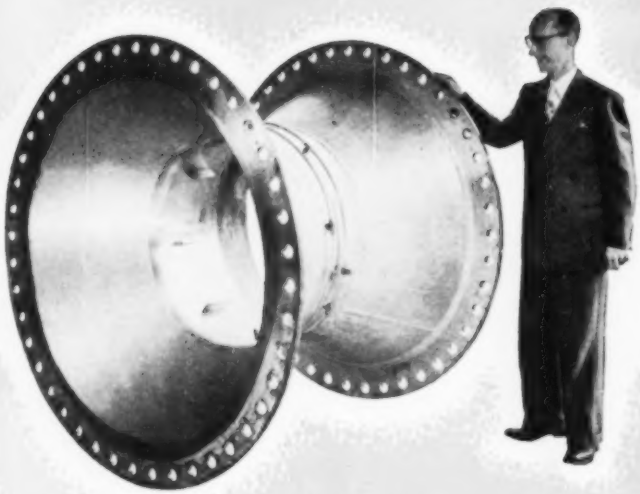
A Service Subsidiary of
THE DOW CHEMICAL COMPANY

tems. Other materials can be used

FOSTER FLOW TUBES

(Gentile Patents)

Are EASIER to Install



This 48" Foster Type D Flow Tube, of lightweight fabricated steel construction for measuring flow of air in the discharge line of a reactor air system, flanged for 125#, is only 48" in length between flanges and weighs only 1350 lbs.—many feet shorter and several thousand pounds lighter than a conventional venturi.

In addition to being considerably easier to handle, the Flow Tube takes up but little space, and needs no straight entering run for normal accuracy, except before and after valves in which case eight diameters are required upstream and five diameters downstream. This means that the Flow Tube can be installed without expensive vaults or housing in any readily accessible point where flow conditions are reasonably steady.

This Flow Tube, one of many for top priority defense projects, was designed to handle 29,300 SCFM at 10.12 PSIA at 238°F with a maximum head loss of 2" H_2O and with an accuracy within ±1% of the calibration curve furnished with it.

Foster Flow Tubes are made for a wide range of services metering the flow of liquids and wet or dry gases. They are available in all commercial pipe sizes, with screwed or flanged connections, bell and spigot, or welding ends, and of any materials required by the service. For further information on Flow Tubes, ask for Bulletin FT-101; and if you would like specific recommendations, please give us processing and installation details of your metering requirements.

FOSTER ENGINEERING Company

835 Lehigh Avenue • Union, N. J.

PRESSURE REGULATORS ... RELIEF AND BACK PRESSURE VALVES ... CUSHION CHECK VALVES ... ALTITUDE VALVES ... FAN ENGINE REGULATORS ... PUMP GOVERNORS ... TEMPERATURE REGULATORS ... FLOAT AND LEVER BALANCED VALVES ... NON-RETURN VALVES ... VACUUM REGULATORS OR BREAKERS ... STRAINERS ... SIRENS ... SAFETY VALVES ... FLOW TUBES

end to the other of a long or divided panel board.

The console is a 60-in. wide steel desk arranged with cutouts to accommodate an Electronik indicator and key switch banks or pushbutton assemblies. The desk is low enough so that full view of the panel board from any part of the control room remains unobscured. — *Minneapolis-Honeywell Regulator Co.*

Contamination Monitor Measures Surface Radiation

(196A) A new portable survey meter is designed for measuring low-level alpha or beta contamination on flat or irregular surfaces. This is said to be one of the most difficult of monitoring assignments.

Housed in an aluminum case, the meter is calibrated for up to 12,500 alpha particle counts per min. An ionization chamber in the bottom is used for table-top monitoring; a connector provides for an external probe containing chamber and preamplifier for checking irregular surfaces.—*Radioactive Products, Inc.*

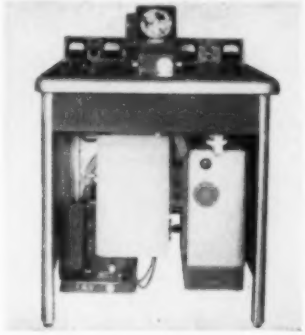
Resistance Thermometer Responds in 1 Sec.

(196B) A new resistance thermometer features a high voltage output (0 to 1 v.) and a thermal time constant which is said to be less than 1 sec. in water. This fast response makes it possible to follow very rapid thermal transients.

Each instrument is provided with a calibration certificate and is guaranteed to have an accuracy of 1 percent of full scale. The resistance change is linear with respect to temperature except for the highest ranges, which have a curvature of a few percent. Top temperature range available extends to 1,000 deg. C.

Standard instruments have stainless steel or Inconel cases and are suitable for high-pressure liquid or gaseous sys-

tems. Other materials can be used where corrosive conditons dictate.—*Trans-Sonics, Inc.*



Electron Microscope Operates Electrostatically

(197A) Differing from the conventional electron microscope, which uses an electromagnetic design, this new instrument incorporates an electrostatic lens system. This system, it is claimed, minimizes certain complexities and offers numerous advantages. One advantage cited is that the electrical center in electrostatic lenses coincides with the geometric center, simplifying the problem of alignment. —*Farrand Optical Co., Inc.*

Orifice Meter For Viscous Flow

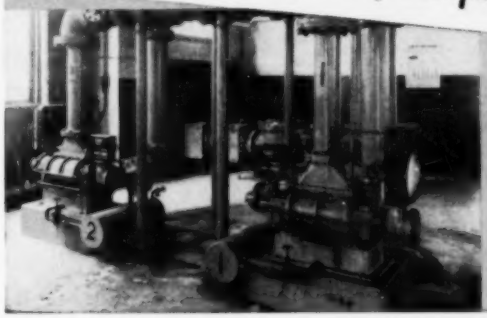
(197B) In an effort to make orifice meters better suited for flow measurements in the viscous range, a new type of orifice has been developed which obtains a stable coefficient over a wide range of Reynolds numbers. The device is said to have a coefficient of discharge which is unaffected by wide variations in the viscosity of the fluid passing through it.

Design of this special orifice is based on the observation that the slope of the coefficient curves (plotting discharge coefficient vs. Reynolds number) is in one direction for square-edged circular orifices but is in the opposite direction for nozzles or venturi tubes. The ideal required for accurate metering is, of course, a horizontal curve of zero slope, or a constant discharge coefficient at any Reynolds number.

The new Type PL orifice is of an intermediate form between a straight edged orifice and a flow nozzle. It represents an attempt to balance the viscosity effects which cause the rise and fall of the coefficients with the two older devices. It consists of a relatively thick plate with a circular orifice, having a short conical entrance,

MEASURE THESE VALUES WHEN YOU BUY METERS

Accuracy·Capacity·Compactness



Part of an installation of nine R-C Positive Displacement Meters in large chemical plant. Capacities from 3,000 cfh to 130,000 cfh.

Industrial buyers rate R-C Positive Displacement Meters "tops" in these basic essentials.

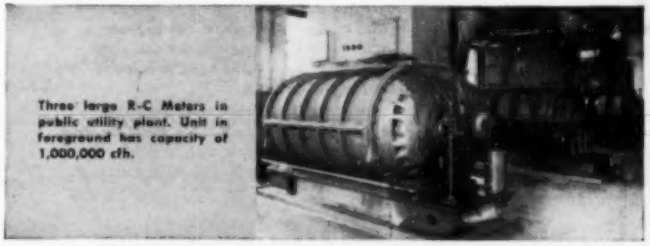
Accuracy—Not affected by pressure, wide variations in loads or other variables. Simple design, with no vanes, valves or small parts, results in maintained accuracy over long years of operation.

Capacity—from 4,000 cfh to 1,000,000 cfh in one unit, to meet practically any industrial metering requirements. Ample ability to absorb overloads.

Compactness—foot for foot of capacity, R-C Meters are the smallest made for industrial use. Can be "tucked away" in relatively small space without loss of valuable production area.

These values have long been proved by large and small industrial plants and public utilities. More R-C Meters are used by gas producing plants, for their own manufacturing and for commercial customers, than any other make. For details on sizes and construction, ask for Bulletin 40-B-14.

ROOTS-CONNERSVILLE BLOWER CORPORATION
524 Illinois Avenue, Connersville, Indiana



Three large R-C Meters in public utility plant. Unit in foreground has capacity of 1,000,000 cfh.

ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES

Imagine the possibilities of using the ocean's unlimited resources as your supply of raw material. That is just what's being done today. It's the result of combining imagination and modern processing equipment designed by Dorr.

In this case, the operation is one of extracting magnesia from seawater at the Cape May, N. J. plant of the Northwest Magnesite Co. Here, the jobs of preliminary treatment of seawater and subsequent thickening and washing of magnesium hydrate are carried out in Dorr thickeners. As a matter of fact, at every major seawater magnesia operation in the U.S.A., these basic processing steps are handled by Dorr equipment.

It's a good plan to talk to Dorr about your new ideas. Whenever a process involves the separation of finely divided solids in suspension, the use of ion-exchange, or fluid techniques, the chances are we can help you turn your imagination into money.

Better tools TODAY to meet tomorrow's demand

DORR

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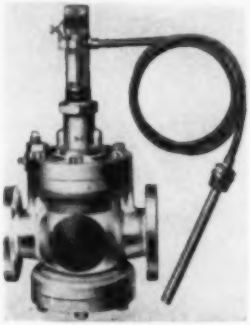
followed by a short parallel portion, used in association with corner tap pressure connections. Thickness of the plate varies with the diameter of the pipe.

A self-contained unit, including the orifice plate and pressure taps, is available in 1 and 2-in. pipe sizes. For larger installations the orifice can be carried between pipe flanges and the pressure taps drilled into the pipe on either side of the orifice.—*George Kent Ltd.*



Temperature Regulator Is Self-Operating

(198A) Type 1005 is a new addition to an established line of self-operated temperature regulators. It features a simplicity of design which allows quick disassembly for relapping and cleaning in the field.

The manufacturer claims control accuracy of 1 deg. F., obtained by means of a balanced single-seated pilot operating on the vapor flash principle. The new regulator is available for steam pressures from 10 to 150 psi. and for temperature control from 30 to 325 deg. F.—*Farris Stacon Corp.*

Instrumentation Briefs

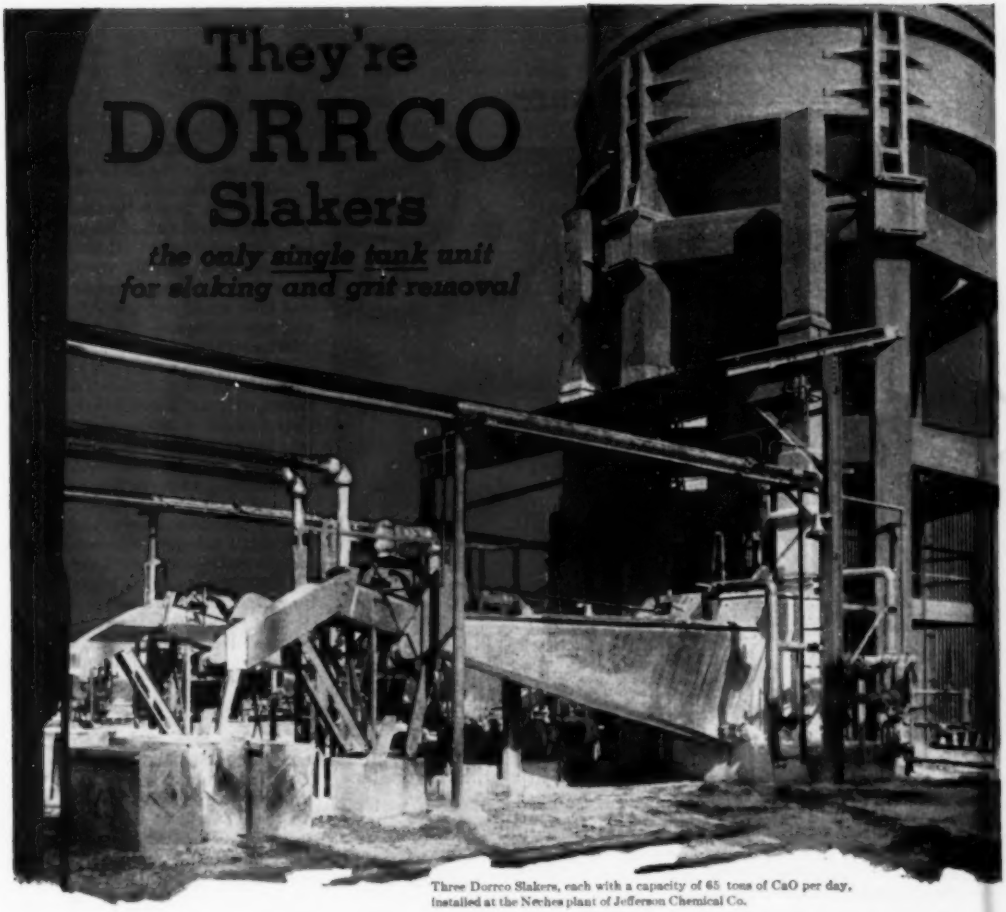
Panelboard Pressure Gage—Combines ½ of 1 percent accuracy with small size (3½-in. dial). For transmitted air pressures in standard ranges. Manning, Maxwell & Moore, Inc. *(198B)*

Instrument Pen—Eliminates flooding, reduces paper plugging and choking. Operates with decreased pressure on chart. Ink level in reservoir is always below writing tip. Minneapolis-Honeywell Regulator Co. *(198C)*

Cleaning Machine—For cleaning delicate instrument parts. Priced at about $280. Zenith Mfg. & Chemical Corp. *(198D)*

They're DORRCO Slakers

the only single tank unit for slaking and grit removal



Three Dorrco Slakers, each with a capacity of 65 tons of CaO per day, installed at the Neches plant of Jefferson Chemical Co.

To simplify your slaking operations, get to know the Dorrco Slaker. It is a neat and compact unit that provides safe and clean operation. There is a size to meet every need . . . from 5 to 200 tons of CaO per day.

Here is a quick look at some of the advantages the modern Dorrco Slaker gives you —

Large unit capacity because mechanism and tank design produces rapid hydration.

Quick installation at low cost . . . your Dorrco Slaker is shipped almost completely assembled, requires no field welding, no costly piping installation.

Low maintenance costs . . . because all bearings are above solution and 1" thick white iron liners in the slaking compartment are designed for quick and inexpensive replacement.

Bulletin No. 7281 gives you more information about the Dorrco Slaker, its compactness, its simplicity and its durability. A copy of Bulletin No. 7281 is yours for the asking. Write for your copy today. THE DORR COMPANY, BARRY PLACE, STAMFORD, CONN.

Better tools TODAY to meet tomorrow's demand.

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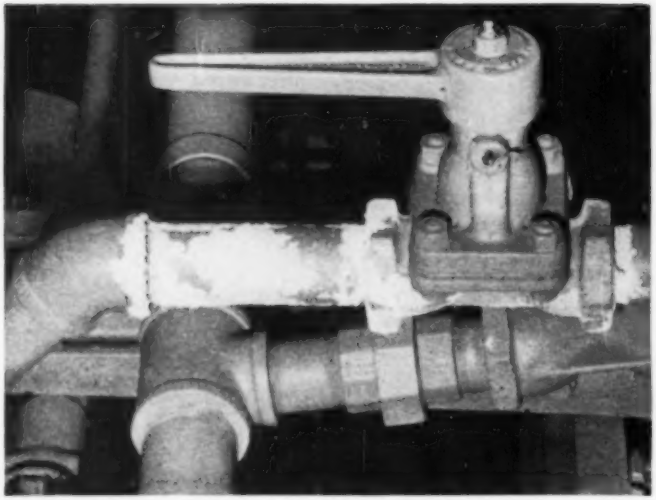


DEL coating on valves and piping was unaffected by thickly caked soda ash.

New Coatings Span CPI

Choose the right member of the line and get protection of metal, masonry or wood against acids, alkalis, water, oils, solvents, weather, high heat and abrasion.

(200A) A growing number of major companies in the CPI are specifying DEL coatings to protect their construction, maintenance and products finishing.

Developed and produced by David E. Long Corp., New York, the line has been on the market only about two years. Coatings are based on vinyls, styrene butadiene copolymers, acrylics, silicones, Epons and phenolics. Already they are being used in chemical, fertilizer and sewage disposal plants, paper mills, petroleum refineries, dairies, breweries, and in the metal fabrication, textile and equipment manufacturing fields.

The products have made this much commercial headway without benefit of formal publicity. First, energetic Dave Long wanted and built up some working case histories to talk about.

American Cyanamid, before choosing protective coatings for its plants, runs comparative laboratory and field tests. As a result DEL combinations are coating the distillery and refining areas in their aureomycin plants and animal biology buildings. These areas are subjected to severe corrosion due to steam, condensation, hydrochloric acid, caustics, butyl alcohol and possible mold and fungus growth.

Cyanamid's entire new streamlined catalyst plant at Michigan City, Ind., (CE, Dec. 1951, p. 224) has been painted with DEL coatings. Here they are resisting sulphuric acid, ammonia and moisture.

The entire Florida plant of company-subsidiary Arizona Chemical is painted with them. They are also used in many other Cyanamid plants for tank farms, lining drums, coating acid tank trucks and general painting in corrosive areas.

Managers of one of the plants of a large electric company standardized on DEL for all the electrical equipment, boxes and panels they turn out. They found they outdid all older coatings for equipment destined for corrosive areas. Other plants use them for electroplating areas, for new construction and maintenance. The company's research and atomic power laboratories use DEL, the latter for lining of tanks and pits storing corrosive liquids.

One of the country's largest breweries has found the coatings superior for bottle washers, soakers, fillers, tanks, walls and floors.

A major chemical company in Philadelphia uses them on equipment exposed to temperatures as low as −350 deg. F. Another company, finding they held up longer in acid areas and were easier to apply, extended their use to many areas. An oil company gets under water protection for the hulls of its tankers with DEL. On the wool-combing machines of a textile mill, the coatings are resisting hydrochloric, sulphuric and fatty acids, caustic soda, soda ash, water, steam and urine.

Each coating is designed for a specific job though there is some overlapping. They can all be applied by conventional methods such as brushing, spraying, roller coating or dipping.

Cyanamid catalyst plant—DEL coats mixing tanks for strong H_2SO_4, ammonia, water.

DEL's series A, heavy duty vinyl copolymer resins, is designed to protect metal and masonry from acids, alkalis, alcohol, oil, gasoline, salts and water. Series B, plastic base acrylic resin, resists acids, alkalis, oil, water and abrasion. It's meant for storage tanks, exterior and interior masonry. Series C, based on synthetic rubber combined with other waterproof plastic resins, is for concrete brick, Transite, asbestos cement siding, stucco, cement and cinder blocks.

For wood, metal and masonry, there is series D based on Epon resin. Resistant to acids, alkalis, alcohols, oils, water and abrasion, they recommend themselves especially to the food industries. With 100 percent plastic rubber base (styrene butadine copolymer), series F provides chemical resistant, elastic, tough, waterproof indoor or outdoor coatings for metal, masonry or wood.

DEL's all-metal washcoat primer Pl-2 is a vinyl resin-zinc chromate-phosphoric type. Transparent weatherproofing W-97, a plastic resin, is guaranteed to remain crystal clear.

Prices range from $4 to $7 a gal. Series A, F and D come in a variety of colors.

And DEL people have new developments underway. In fact, they've just added two new members to their line. Varnish S-1, a modified phenolic, protects against solvents and acids, costs $9.25 a gal. They designed aluminum No. HH, a modified silicone, for use on hot surfaces up to 1500 deg. F. It sells for $12.75 a gal.

Acrylic Fiber

Can be dyed at normal temperatures with several types of dyes. *(201A)*

American Cyanamid has just come out with a new acrylic fiber known temporarily as X-51. Pilot plant quantities of two types, a wool-like staple and a silk-like yarn, are being produced at Stamford, Conn.

The ease and effectiveness with which it can be dyed sets it apart from other acrylics. It will take a full range of shades; vat colors are especially good.

Virtually no equipment modifications are necessary to process it in cotton or wool mills. Wool-like textiles with the strength of cotton fabrics are obtained.

Due to the exceptional solvent resistance of polymers made up largely of acrylonitrile, X-51 is neither dissolved nor softened by the usual organic solvents. In general, its resistance to acids is very good, with a tendency to bleach. Resistance to alkali is fair with a tendency to yellow under severe conditions.

Resistance to attack by insects or by mildew is excellent. Soil burial test of fabric in severe ASTM vertical method showed no change after six weeks' exposure of soil microorganisms.

Whether or not the fiber is to get into full plant production depends on its reception by industry.

IN BRIEF—A capsulated listing of this month's newsworthy products

It's New . . .	It's Good For . . .	See Page . . .
Protective Coatings	Chemical, fertilizer, sewage disposal plans	200A
Acrylic Fiber	Producing wool-like textiles with cotton's strength	201A
Antioxidant	GR-S and synthetic rubber	201B
Polyvinyl Acetate	Its freeze resistance, stability in storage	201C
Mud Treatment	Safer control of oil well drilling mud	201D
Metal Cleaner	Spray or immersion cleaning of metals	204A
Resin	Shrinkage, crush and spot resistance in rayon	206A
Surface Active Agent	Rewetting and surface tension lowering	206B
Metal Primer	Severely corroded metal surfaces	208A
Varnish	Making laminated plastics with high impact strength	209A
Monomers	Applications in polyesters, cross-linking agents	209B
Tube Cleaner	Removal of carbonaceous deposits from oil heater tubes	210A
Plastic Molding	Improving impact strength in electronic devices	210B
Fungicide	Upping textiles' mildew resistance with one bath	210C
Polyvinyl Plastic	Easily installed water stop	210D

Antioxidant

A mixture of styrenated phenols for use with both GR-S and natural rubber. *(201B)*

Styphen I has been developed by Dow Chemical Co. to combat oxidation in both GR-S and natural rubber. Chemically, tris (α-methylbenzyl) phenol mixture, the product is currently available in commercial quantities.

Extensive testing in rubber research and production laboratories has shown outstanding non-staining properties which should make it especially useful in the protection of such rubber articles as white side wall tires, refrigerator gaskets and electrical wiring insulation.

Storageability and protection against surface crusting are said to be vastly improved with the addition of 1.25 percent Styphen I.

Polyvinyl Acetate

A water solution which produces air-dried films with high water resistance. *(201C)*

Suggestions for use of Dewey and Almy's new Polymer Y are based on the following properties: unaffected by freezing; stability in storage; improved gloss; water resistance; easily removed by slightly alkaline solution.

It will probably move in on some applications of polyvinyl acetate emulsions. It is also recommended as a substitute for solvent solutions of polyvinyl acetate.

Chemical plasticizers which are ordinarily used with polyvinyl acetate emulsions may be used to plasticize Polymer Y. To give it an unusually flexible yet nonsticky film, 10 percent of a plasticizer is sufficient.

Mud Treatment

Two chemicals for cheaper, safer control of oil well drilling mud. *(201D)*

Full scale commercial production of two new products, Hydrotan and Hydrocarb, will begin in May at Columbia-Southern Chemicals Corp.'s Corpus Christi, Tex., plant.

Hydrotan controls the viscosity of drilling mud and by being a colloid adds other desirable properties in the process. It is an alkali tannate (caustic and quebracho).

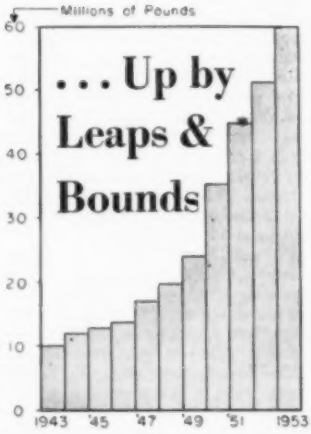
Hydrocarb can be used instead of quebracho in some cases. In time it may replace the Argentine import. It is a combination of lignite and caustic. These are first dehydrated and an agent, possibly calcium carbonate, halts the deliquescent tendency of caustic.

Both Hydrotan and Hydrocarb are dry products packaged in paper bags ready for use. This will permit improvement over the present way of mixing quebracho and caustic on the drilling site with considerable loss of both dry constituents and some hazards to handlers.

The new Corpus Christi plant, for grinding, compounding, drying, mixing and bag filling, will be capable of processing 200 to 300 tons a month.

Prices to consumers near the plant will be 18 to 20 cents a pound for Hydrotan, 15 to 16 cents for Hydrocarb.

Pentaerythritol Production . . .



Strong growth of pentaerythritol market is bound to its use in alkyd resins.

Between 1947 and 1951 pentaerythritol production jumped from 17.5 million to about 45 million pounds. Recent expansions of Hercules Powder Co. and Heyden Chemical have brought the yearly capacity to an estimated 60 million pounds—and it is predicted that by 1953 the industry will be actually producing this much.

What's more, Canada is getting into the market for the first time with a double entry. One reason: spectacular four fold increase in Canadian consumption between 1947 and 1950.

Canadian Chemicals Co. Ltd., a Celanese Corp. of America affiliate, will produce PE at a plant at Edmonton to be completed by the end of this year. Scheduled output is considerably in excess of the 2 million pounds consumed in Canada during 1951. Since the company is also a producer of PE raw materials, production costs will be low enough to offset tariffs involved in selling to the U. S.

The second entry is a joint plant announced by Shawinigan Chemical Ltd. and Heyden Chemicals. To be built in Quebec, it will have a capacity of 3 million pounds.

Generating all this activity is a strong trend toward using more PE in alkyd resins, ester gum resins and synthetic drying oils. Just about half of the growth of alkyds in recent years has been due to PE types; glycerine alkyds have grown at a much slower rate. The period 1947 to 1950 witnessed a 36 percent growth in alkyd resins and ester gums, approximately a 25 percent growth in glycerine used, a 100 percent growth in PE used.

More than 35 million pounds a year of PE are now going into alkyds (half of the glycerine usage). PE has taken over a major portion of the long oil alkyd resin field, is replacing glycerine more and more in medium oil alkyds. Only in short oil alkyds, where higher functionality of PE causes difficulty in formulation, has it not gained ground.

A limiting factor on the growth of alkyd resins (and thus PE) is the phthallic anhydride shortage. However, relief is in sight as the Barrett Division will complete two plants in 1953—one in Chicago, 25 million pounds; on in Philadelphia, 20 million pounds. And Monsanto, Oronite and Reichhold are thinking seriously of building plants.

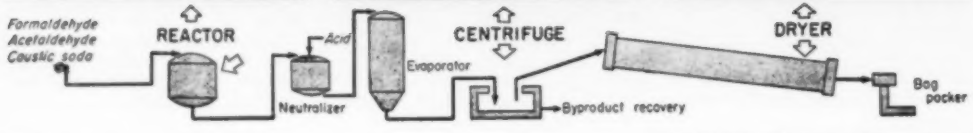
PE is attacking glycerine in alkyd resins on two fronts—price and quality. Also supplies have been more reliable.

It requires less expensive (unsaturated) oils than an equivalent glycerine alkyd and needs less dibasic acid. Price structure has been much more stable ranging from a low of 27 cents in 1946 to a high of 34 cents today. Glycerine has fluctuated from a low of 20 cents to a high of 60 cents in 1950-51. Glycerine's present downward price trend hasn't noticeably affected PE thus far.

According to manufacturers, PE can produce resins that are tougher, more water and alkali resistant, faster drying, more flexible, more durable and have better color stability and gloss. Many of them claim that the steady increase in use is due more to its unique properties than to the fact that it's cheaper.

Others, however, insert this word

How Heyden Makes Pentaerythritol



How Celite Mineral Fillers make a product free-flowing...

Keeping fertilizers "On the run"

REALIZING their product is one that cannot "cake-up" and still survive in a competitive market, leading producers of fertilizer use one of the Celite Mineral Fillers as a standard "anti-caking" ingredient.

The ability of Celite Fillers to keep a product free-flowing results from their high absorption properties and unique diatom structure—properties which make them unusually effective safeguards against caking in deliquescent materials. They are two of the unusual physical characteristics that adapt these diatomaceous silica powders to numerous industrial uses.

THESE CELITE PROPERTIES BENEFIT MANY TYPES OF PRODUCTS

Because of their inertness and great bulk per unit of weight, Celite Mineral Fillers make ideal bulking agents for powders and pastes. Their tiny multi-shaped particles interlace to stiffen and strengthen admixtures. The microscopically small facets of these particles diffuse light so effectively that they can be utilized to impart any desired degree of flatness to a surface film. Their light, porous nature improves suspension, helps prevent segregation. And their porous, thin-walled cellular structure imparts a delicate non-scratching abrasive action.

You may find Celite the "extra something" needed to lift your product above competition. Why not discuss its application to your problem with a Celite engineer? Or write for further information and samples to Johns-Manville, Box 290, New York 16, N. Y. In Canada: 199 Bay St., Toronto, Ont.

CHECK LIST OF PRODUCT BENEFITS OBTAINABLE AT LITTLE COST WITH CELITE MINERAL FILLERS

- Added Bulk
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- Faster Cleaning Action
- Greater Absorption
- Improved Color
- Better Dielectric Properties
- More Durable Finish
- Increased Viscosity
- Elimination of Caking
- Higher Melting Point
- Better Dry Mixing
- Improved Dispersion

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MINERAL FILLERS

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This revolutionary new Kidde extinguisher is so safe, so sure, you'll find it a necessity for trucks, garages, factories—wherever there is a danger of small fires.

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5. ***POWDER WON'T PACK.*** **Perfect for trucks, garages, factories, etc.**

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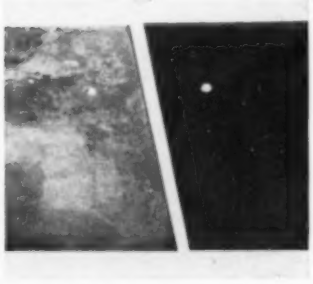
Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.

of caution. In a relatively few years of its commercial production, PE has had several important economic breaks which have shielded it somewhat from demonstrating its true value with relation to glycerine.

First manufactured in the early 1930's by Niacet, Trojan Powder Co., then Heyden Chemical, its principal use was in making the explosive, pentaerythritol tetranitrate. The Sino-Japanese conflict which cut off tung oil imports spurred production of a grade of PE to suit the economics of the resin and oils market. About 1939, Hercules entered the field. The higher price of glycerine during World War II and several of the postwar years made it economically sound as well as technically advantageous to make the substitution.

Today the big three in PE manufacture are Trojan, Hercules and Heyden. Their respective estimated capacity for 1952 is 10, 16 and 24 million pounds. Commercial Solvents and Delaware Chemical have started manufacture on a limited scale.

One of the newest uses for PE is in nonionic wetting agents for the manufacture of emulsions, dispersions, liquid wax compositions, coatings, pharmaceuticals, synthetic rubbers. Plasticizers and rust resisting lubricants are also beginning to take a share of them.



Metal Cleaner

Panel, left, cleaned with new product shows no rusting after three weeks normal plant exposure. Another emulsion cleaner was used on rusted panel. (204A)

Steels parts cleaned in Pennsalt's new EC-51 are said to remain free from rusting for up to six weeks under normal plant conditions. Even under unfavorable conditions, protection for two to three days can be expected.

An organic-type cleaner, it is noncaustic, nonexplosive, harmless to the hands and does not create toxic work-

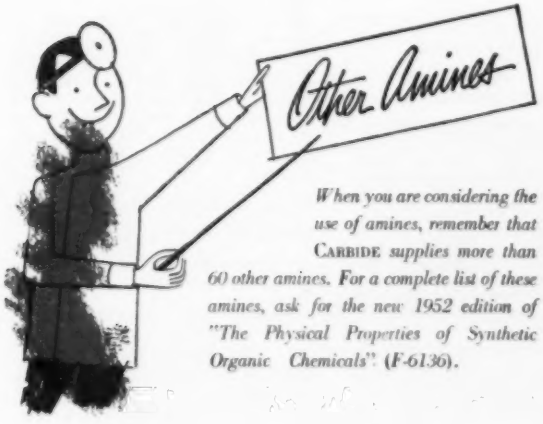
℞ Acid-neutralizing Diethanolamine
A mild, non-caustic base is often just what the doctor ordered to cure a particular product or process problem. Time and again Diethanolamine has proved to be the right answer. Have you investigated it for your product or process?

Diethanolamine
$(HOCH_2CH_2)_2NH$

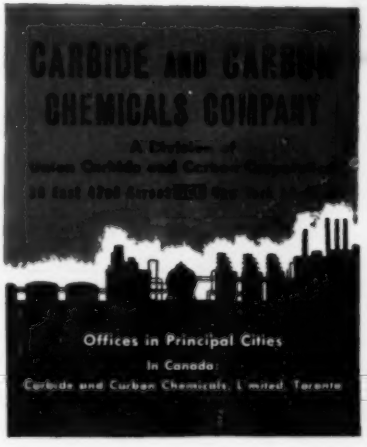
Here's how you can use it:

- to absorb acidic gases. Excellent for scouring H_2S and CO_2 from refinery gases.
- as a solubilizing agent for 2,4-D.
- its sulfamate salt is a superior flame-retardant and softener for paper (ask for our technical bulletin, "Alkanolamine Sulfamates As Flame-Retardant Paper Plasticizers," F-7415).
- as a softening, moistening, or emulsifying agent.
- in the production of powerful synthetic detergents.

Diethanolamine is readily available in commercial quantities from Carbide and Carbon. Call or write any CARBIDE office for prices and information.



When you are considering the use of amines, remember that CARBIDE *supplies more than 60 other amines. For a complete list of these amines, ask for the new 1952 edition of "The Physical Properties of Synthetic Organic Chemicals". (F-6136).*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ing conditions. It is said to be equally efficient in removing soil from all of the nonferrous metals without staining or etching.

Field tests have proved it successful in cleaning prior to painting. Pieces cleaned in EC-51 can be painted directly after rinsing and drying without further treatment. EC-51 is used in concentrated or diluted form and can be applied by both spray and immersion methods.

Resin

Imparts lasting water repellency, spot, wrinkle, crease and shrinkage resistance to rayon and rayon blends. (206A)

At least two compounds and operations have previously been necessary to produce rayon improvements which Warwick Chemical claims for its new one-resin treatment.

Called Noraset, the compound is described as a hydrophobic resin. Monomeric solvent-soluble and water dispersable, it is thermosetting but not melamine. Beneficial rayon properties are said to result from a particular group in the chemical structure.

Application is by conventional methods—simply impregnation of the cloth through a solution of Noraset, followed by squeezing, drying and then baking at elevated temperatures. During baking or curing, Noraset is converted to an insoluble, infusible resin within the fibers. It also undergoes chemical combination with the fiber molecules. As a result its effects are durable to washing and dry cleaning operations.

Actually two Noraset products have been introduced, the first of a family of products. Noraset A produces shrinkage control, crush resistance, spot resistance and durable water repellency. Noraset GG, by itself, yields primarily durable water repellency and spot resistance. It was specially designed for applications where particular stabilizing and crushproofing resins are preferred by the textile finishers. Prices are 29 cents a pound for A, 55 cents for GG.

Surface Active Agent

For the textile, paper, plastics and surface coating industries. (206B)

Stability, good detergent, rewetting and surface tension lowering characteristics, along with moderate antiseptic action are claimed for American Cyanamid's Aerosol SE.

A quaternary ammonium compound, it is a 50 percent solution of

3 MAJOR SAVINGS FOR PURE CARBONIC WITH FRUEHAUF TRAILERS

Pure Carbonic, Incorporated, operates two of these insulated Fruehauf Aerovans for fast transport of dry ice from its plant in Berkeley, California, to the warehouse in Sacramento.

SULPHURIC ACID

LIQUID LATEX

CAUSTIC SODA

LIQUID CARBON DIOXIDE

THREE MAJOR SAVINGS result for Pure Carbonic, Incorporated, in its operation of Fruehauf Aerovans for hauling dry ice.

1. Costly evaporation is prevented because of rapid, direct delivery and the protection of Fruehauf's cold-retaining insulation.

2. Expensive freight re-handling is eliminated because Trailer Transport involves only one hauling and handling operation.

3. Maintenance costs are low because of sturdy Fruehauf construction. Patented Multi-Rate Suspension effects substantial maintenance savings.

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SAVINGS IN *YOUR* BUSINESS, plus greater hauling flexibility, are possible with "transportation by Fruehauf." Write for a free "Transportation Cost Analysis" or call your nearest Fruehauf Branch.

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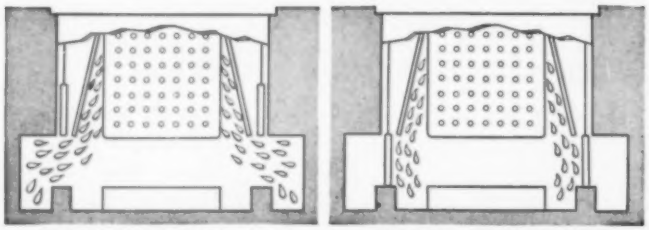
LOOK!

2 successive liquids separated without mixing



CURB OPEN to permit first liquid to be separated and evacuated from machine.

CURB SHUT, second liquid is separated and removed through lower outlet without mixing with first liquid.

Industry benefits from broad use of centrifuging . . .

thanks to new AT&M developments. The centrifugal above — a profitable investment wherever two or more liquids are separated in a cycle — is but one of many outstanding AT&M centrifugals that save time, space, costs.

As the drawings above show, this curb is designed to remove two *successive* liquids without mixing. With the curb open, the first liquid is separated and evacuated through the curb outlet. The curb is then closed and the second liquid is separated and removed through a different outlet.

You, too, can benefit with AT&M equipment. Does away, in many instances, with settling tanks, filter presses, squeeze rolls, vacuum presses. Used in processes involving chemical preparations — explosives — nitrating — acid wringing — ammonium sulphate — food products — soap — drugs, medicines, cosmetics — oils and greases — paints, varnishes — ceramics, brick, clay — fertilizers — nitrates — sludges — textiles — carbonizing (textiles) — plastic bases.

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P.S. PROVE TO YOURSELF how centrifuging can benefit you. Send us a sample of your material for centrifuging to your specifications or rent an AT&M laboratory centrifugal for your own tests at a nominal fee.

FUME-PROOF. No gases can escape from this specially designed AT&M centrifugal. Its fume-tight hood — originally developed by AT&M engineers to solve a special problem — is now used to advantage by many firms processing volatile liquids.

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SAVE TIME, SPACE AND COSTS WITH **A.T. *and* M. CENTRIFUGING**

stearamidopropyldimethyl 1-B-hydroxyethylammonium chloride in an isopropanol-water mixture. It is a light straw-colored liquid, soluble in water in all proportions.

The new product is an active detergent in acid media, in hard water and in salt solutions, and is an effective cationic scouring agent for wool and other textile fibers. In experimental use in the textile industry, it has proved an efficient aid in stripping vat-dyed rayon and cotton fabrics and in stripping metallized dyes from wool. In applying metallized dyes to wool, Aerosol SE permits a reduction of as much as 50 percent in the amount of sulphuric acid in the bath.

As a wetting agent, it is effective for both textiles and paper, particularly in rewetting papers that have been treated with wet-strength resins. It is a good emulsifier for mineral oil, waxes and alkyd resins in water, and has been successfully used during the polymerization stage in preparing thermoplastic resin emulsions. In the paint field, Aerosol SE can be used effectively for the deflocculation of certain pigment presscakes and as a pigment dispersant.

The new product will be sold to the textile industry as Deceresol SE, to the paper industry as Paper Product 200, and to other industries as Aerosol SE.

Metal Primer

Effective on severely corroded metal surfaces; dries over-night. (208A)

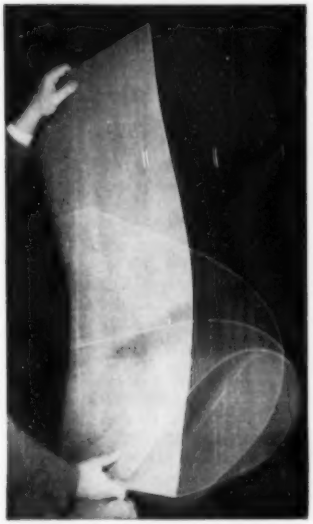
Prufcoat Laboratories' new Primer P-50 is said to have the application simplicity and effectiveness of the commonly used zinc chromate and red lead types of primers. More than that, it's said to require only over-night drying prior to the application of finish coats.

It is composed of a heavy-bodied oil-modified synthetic resin vehicle, carrying a high percentage of inhibitive pigments, principally zinc chromate. It deposits a relatively heavy primer film which tends to level out rough surfaces and provides protection at sharp edges, rivets, projections and other vulnerable points. Coverage on smooth metal averages 400 sq. ft. per gal.

It is effective from an inhibitive standpoint on iron, steel, aluminum and magnesium. It also exhibits good adhesion to brass copper, lead and Monel metal.

On jobs involving both conventional paints and protective coatings, Prufcoat Primer P-50 may be used as the single primer for the entire job.

Its overnight drying feature makes it practical for use with active-solvent coating products.



Rubber-Phenolic Varnish

Produces laminated plastics with outstanding flexibility and resistance to impact. *(209A)*

Gears, shuttles, and tubing and castor wheels are representative of the jobs where rubber-phenolic laminates are expected to make contributions.

GE's new rubber-phenolic varnish, 12359, has been formulated to tackle these tough mechanical applications where higher impact and greater flexibility and toughness are required. Laminated plastics made with it are said to have three times the impact strength of those made with conventional varnishes.

Heretofore, phenolics have been considered too brittle for the paper-coating field. However, tests indicate that rubber-phenolic varnishes applied to papers for packaging give increased strength and improved resistance to moisture.

Two Monomers

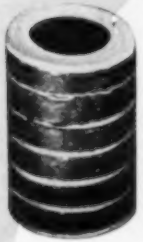
Promising tools for the production of new plastics and low pressure laminants. *(209B)*

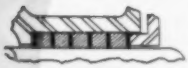
Ethlyene glycol dimethacrylate and diallyl maleate have been put into commercial production by American Monomer Corp., Leonminster, Mass.

Demand for the monomers is expected to grow out of applications in polyesters, cross-linking agents in

CHEMISEAL PACKINGS

Give Months Instead Of Hours Of Service





NO. 711 CHEMISEAL PACKING

NO. 620EG CHEMISEAL PACKING

Hundreds of reports say Chemiseal Packings are doing a good job on installations where other packing materials failed completely.

Good reason—they are made of Teflon* which resists all chemical attack excepting only molten sodium and fluorine. Chemiseal packing cannot contaminate the process. They require light gland pressure, permitting free shaft and spindle action, and are good from —110°F. to 500°F.

For rotating or reciprocating shafts, select Chemiseal Type 711—the packing that imposes least torque on the shaft and not only prevents axial seepage, but seals against stuffing box and shaft as well.

For emergency service, select Chemiseal Extruded Packing No. 620EG (graphite impregnated) or No. 620EM (with mica), applicable to valves, pumps, or any stuffing box application. Write for catalog or tell us your specific packing problems.

*duPont's trademark for its tetrafluoroethylene resin.

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WITH THIS NEW, SELF-CONTAINED

DRUM RINSER

This new, low cost unit provides a fast, practical method of cleaning drums at chemical and petroleum plants and terminals — eliminating the need for returning drums to reconditioning plants before every refill. To every industry using drums which can be cleaned by petroleum-based solvents, it offers a route to large-scale savings. *One oil company expects savings of $12,500 a year after installing a drum rinser and barrel filling equipment in a bulk plant handling 2500 barrels annually.*

Every inch of the interior surface of a drum is scoured in less than a minute . . . sand and similar substances are removed without draining. No piping of air lines is needed — just one electrical connection.

WRITE TODAY for prices and literature.

Gilbarco

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copolymerization, resins, rubber chemicals, coatings, drying oils, pharmaceuticals.

Both ethlyene glycol dimethacrylate and diallyl maleate are colorless liquids; the former has a boiling point of 122-126 deg. C. at 15 mm. and the latter, 109-110 deg. C. at 3 mm. Specific toxicity data is not available on either of them so they must be handled with caution. Both show a tendency to gel on long standing and should be stored in a cool place.

The diallyl maleate is uninhibited and may be used as received. The dimethacrylate has to be purified of the inhibitor for optimum results.

Price of diallyl maleate in 10 drum lots is 73 c., fob. Leominster. Corresponding price of ethylene glycol dimethacrylate is $6.50.

Removal of carbonaceous deposits from the tubes of fuel oil heaters can be accomplished without dismantling the equipment with new cleaner, Magnus 751. Magnus Chemical Co., Garwood, N. J., makes the product. *(210A)*

New plastic molding material, a fiber glass and plastic resin combination, is said to have a higher impact strength than any other plastic. Made by Libbey-Owens-Ford's Plaskon Division, it should find use in electrical switchgear and electronic devices of many kinds. It will be sold in two forms, Plaskon Alkyds 440 and 442 at $1 and $1.10 per lb., respectively. *(210B)*

One-bath treatment for textiles requiring both mildew resistance and water repellancy has been developed by Nuodex Products Co., Elizabeth, N. J. Called Quindex W. R. 10%, the fungicide contains solubilized copper 8-quinolinolate. *(210C)*

Water stop made of B. F. Goodrich's Geon polyvinyl plastic is being used at the Guayabo Hydroelectric project, El Salvador, Central America. The water stop is much easier to install than types previously used in dam construction. It is said to provide superior aging characteristics, extreme resistance to the chemical action of concrete and resistance to temperature changes that occur when concrete is poured and sets up. *(210D)*

CE's Guide to
NEW TECHNICAL
LITERATURE
See page 324

Why the CASH STANDARD Streamlined PRESSURE REDUCING VALVE TYPE 1000

. . . . DOESN'T BECOME GUMMED UP FROM DIRT-SCALE AND VISCOUS MATTER . .

Available in sizes ¼" to 2". Each size with expanded outlet if desired.

● There are no complicated inside works in the "1000" valve. As a matter of fact there is only the one vital moving part — the seat piston. There are no restricted passages, no small ports, no aggregation of close fits. It's streamlined all of the way.

The seat piston is opened in a positive manner by the force of the initial pressure and is closed in an equally positive manner by the force exerted by the delivery pressure on the diaphragm. The seat piston is tied to the diaphragm by the rocker arm so that when the diaphragm moves it must move too.

Thus, the positive moving valve arrangement in STREAMLINED housing, with its continuous-duty performance insures against trouble from gumming up, thereby minimizing maintenance.

PERFORMANCE RESULTS FROM *Streamlined Flow*

1. Maximum Capacity when needed most
2. Accurate Pressure Control under toughest working conditions
3. Trouble-free Service
4. Smooth Operation
5. Tight Closure
6. Accurate Regulation
7. Speedier Production Results
8. Elimination of failures
9. Constant Delivery Pressure
10. Cost Saving Operation
11. No Spoilage
12. Practically zero in maintenance costs

Write for Bulletin "1000" which gives details on the performance of this "Streamlined" 1000 valve and its benefits.

How Streamline Design Works

● Flow has been streamlined for straight flow into the delivery passage and (e). See FIG. 1. The fluid

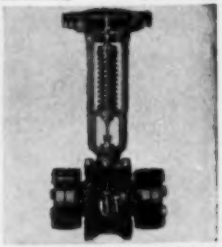
FIG.-1

flows smoothly around this valve with no back eddies to cause turbulence. See FIG. 2, on the downstream side of its trailing edge. In a reducing valve all the pressure drop or work of pressure reduction should occur at one place, namely where the valve throttles flow, and not on the downstream side of the valve. Where you have downstream turbulence, See FIG. 2, the greatest amount of turbulence with resultant greatest pressure drop will occur when you want maximum flow and therefore want least pressure drop—if the delivery pressure is to be maintained. With

FIG.-2

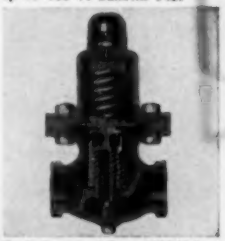
Streamlined Flow, See FIG. 1, you get maximum capacity, plus close delivery pressure control.

OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Type 33 Relief Valve; in various metals to handle nearly all fluids. Has Roller guides on valve spindle; also roller bearing to take care of spring torsion. Sizes ½" to 3" screwed ends; 1" to 12" flanged ends. Bulletin 971.

Cash Standard Type Q Relief Valve has side inlet, bottom outlet. Popular for pump by-pass use. Sizes ½" to 2" screwed ends. Relief pressures up to 350 lbs., temperatures up to 500°F. Bulletin 943.



Cash Standard Type 4190 Valve for relief (bypass) use; holds constant valve inlet pressure regardless of changes in load or outlet pressure. Multiport—large capacity. Iron or bronze bodies; iron or bronze trim. Sizes ½" to 2" screwed ends; 2" to 6" flanged ends. Bulletin 952.

CASH STANDARD CONTROLS . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

Charging bags of pellets into a retort, to remain for 9¼ hr. at 2,140 deg. F., under vacuums as low as 100 microns.

Silicothermic MAGNESIUM

A CHEMICAL ENGINEERING PICTURED FLOWSHEET

As mentioned in the feature article on p. 148 of this issue, silicothermic magnesium is not competitive at the present time with electrolytic magnesium. However, electrolytic magnesium plants cannot supply the demand created by the Korean war and related developments. So it is that standby silicothermic magnesium plants have been reactivated.

Batch process

This does not necessarily mean that silicothermic plants will never produce competitive magnesium. True, the process is batch—and this is the main reason for higher costs. But a continuous process is under development, and other process improvements are continually being made.

One of the recently reactivated silicothermic magnesium plants is operated for the government by Kaiser Magnesium Co., subsidiary of Kaiser Aluminum and Chemical Corp. at Manteca, Calif. This plant was built and operated during World War II by Permanente Metals Corp. Our foldout Pictured Flowsheet on the opposite page relates to this plant.

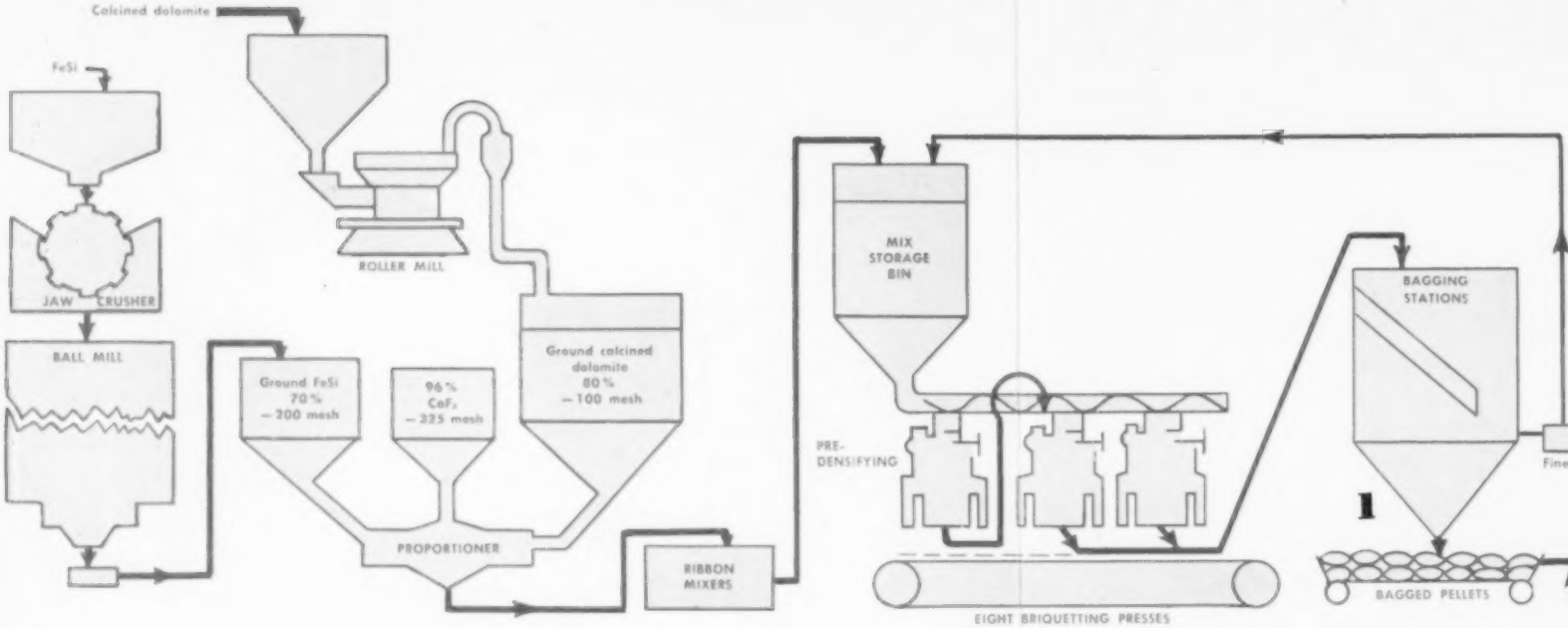
Principal raw materials for the silicothermic magnesium process are calcined dolomite and ferrosilicon. These materials are pelleted and placed in elongated paper bags to form the charge to the retorts.

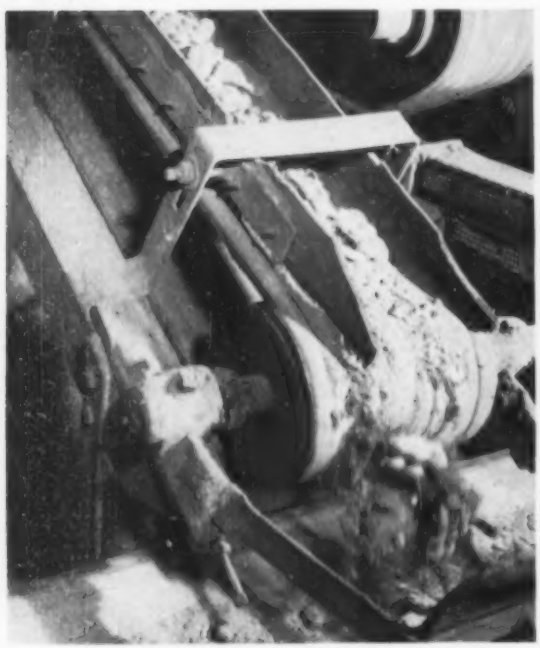
Manteca has two furnace buildings, each with two rows of 16 brick furnaces. Each furnace has 16 stainless steel retorts. A retort is 10 ft. long and 10 in. in diameter. It extends into the brick furnace where natural gas is burned to create a 2,140 deg. F. temperature within the retort.

Retorting

Retorts are designed to take five of the paper bags of pellets, a heat dam and then a short piece of steel tube which just fits the 10-in. diameter of the retort. The retort is closed and the process starts. Simply, the heat volatilizes the magnesium from the pellets. The outward end of the retort is water cooled, which brings the temperature down low enough to allow the magnesium to crystallize in the steel tube. The process takes about 10 hr.

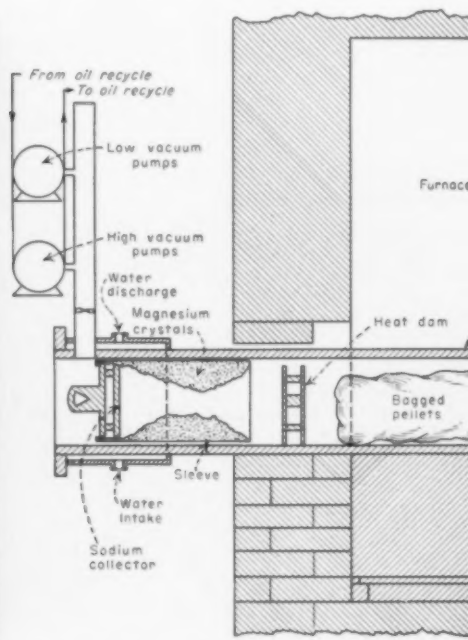
After the magnesium crystals are removed they are taken to the foundry for further refining and pouring into ingots. The new metal is shipped under direction from GSA.



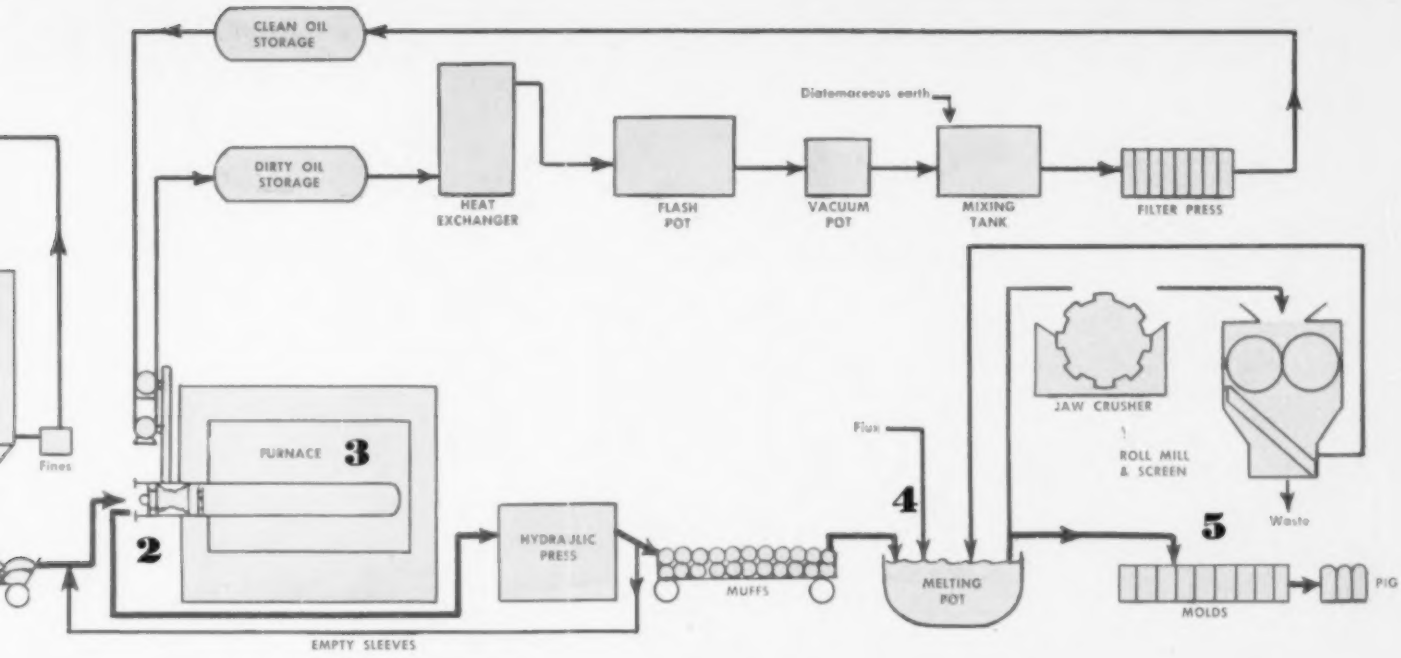


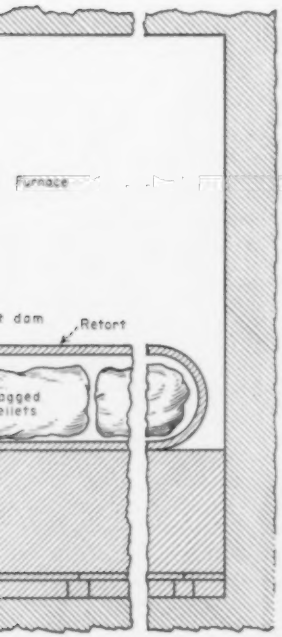
1 Pellets with a density of 72 lb. per cu. ft. on their way to be bagged in 40-50 lb. 2-ply kraft paper bags before retorting.

2 Pulling out sleeve from retort. Vaporized magnesium has condensed on the inside of the sleeve in the form of a crystalline muff.

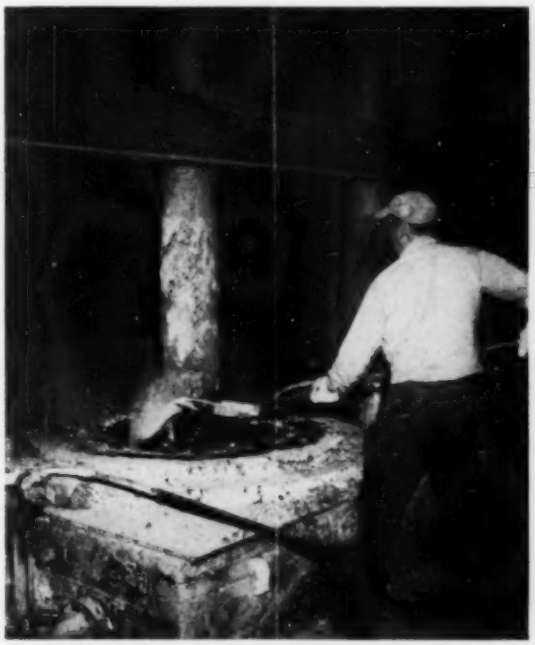


3 Retorting operation. Under vacuum, vaporized magnesium passes over heat dam before being condensed on the wa

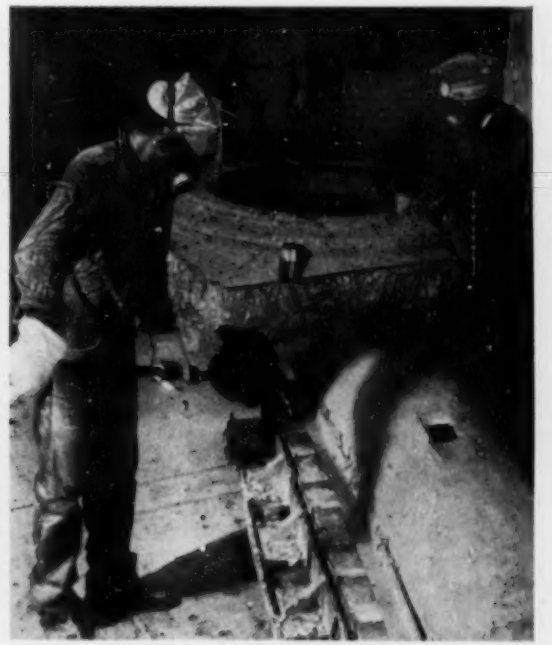




agnesium from bagged pellet charge
the water-cooled sleeve.



4 Shoveling in flux to eliminate impurities. In combination with elemental sulphur, the flux also reduces surface ignition.



5 Hand ladling metal into molds. Central cover over the molds provides a sulphur dioxide atmosphere, reducing surface ignition.

NOW . . . FOR RING TYPE JOINTS

The making and breaking of joints—even with ring-type joint flanges—is accomplished with minimum production delay when you use resilient Flexitallic Spiral-Wound Gaskets. Only 1/16-inch breakaway is required, compared with 1/2-inch to 3/4-inch with conventional gaskets. Ring-type joint flanges already installed are quickly adapted to compression-gauge style Flexitallic Gaskets. Maintenance economies are the same as those enjoyed with raised face, smooth face, vanstone and lapped joints. Especially recommended for joints at valves or where there is close manifolding of the piping . . . It's the spiral-winding of the V-crimped metal plies, alternating with plies of filler, that gives the Flexitallic Gasket its *soring-action* or resiliency. Flexitallic Gaskets are engineered for pressures from vacuum to 2500 lbs. For temperatures from -200° F. to 1800° F. For all standard joint assemblies in four thicknesses: .125", .175", .250", .285". For special joint assemblies up to 104" I. D. Teflon may be used as filler material where ordinary fillers would corrode. Write us your requirements . . . Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult your Classified Telephone Directory.

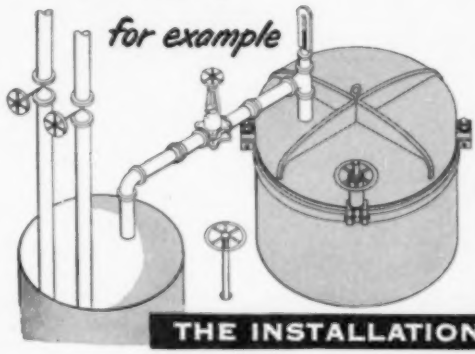
Flexitallic
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* in gaskets with asbestos filler.

Is Corrosion Problem?

...on Acid Solutions Like This,



In acid dye line to package dye machine at Phoenix Dye Works, Chicago, Ill.

THE HISTORY

Various valves and cocks previously tried in this service gave much trouble with leakage and sticking, needing excessive maintenance and lasting only 1 to 2 months at best. Valve almost constantly in contact with varying acid dye solutions at temperatures ranging from 50 to 210 degrees F. Operated about 100 times daily, often with disc in throttling position.

Since installing a Crane No. 18850 all 18-8 Mo Stainless Steel Plug Gate Valve—more than 3 years ago—user reports: no leakage through valve . . . no sign of corrosion . . . no maintenance expense . . . unusually easy operation. Highly enthusiastic about Crane Plug Gate Valves.

The Complete Crane Line Meets All Valve Needs. That's Why,
More Crane Valves Are Used Than

CRANE VAL

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chic
Branches and Wholesalers Serving All Industrial A

VALVES • FITTINGS • PIPE • PLUMBIN

n Your Valve

VALVE SERVICE RATINGS

SUITABILITY:
O.K. for acid dye solutions

MAINTENANCE COST:
None; lubrication only

CORROSION-RESISTANCE:
Excellent; no sign of corrosion

SERVICE LIFE:
Good as new after 3 years' Constant service

OPERATING RESULTS:
No leakage; no production loss easier valve operation

PRICE:
In line with good alloy valves

AVAILABILITY:
Regular item in Crane alloy line

THE VALVE

One of the finest in the Crane line for corrosive service—No. 18850 Plug Gate—with 18-8 Mo stainless steel in all parts exposed to flow, including packing gland. Circular tapered plug seating performs with equally high efficiency on precise throttling or where unrestricted flow is needed. These valves also made in all Monel. See your Crane Catalog or Crane Representative.

hy,
ed Than Any Other Make!

ALVES

ve., Chicago 5, Illinois
dustrial Areas

MBING • HEATING

RAYMOND

WHIZZER SEPARATION

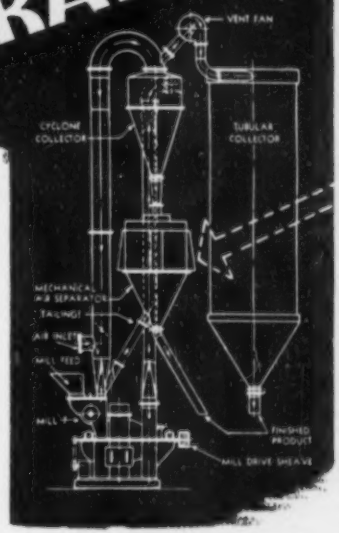
For

CLASSIFYING SUPERFINE MATERIALS

and

DEDUSTING GRANULAR PRODUCTS

RAYMOND MECHANICAL AIR SEPARATORS are available in the Single Whizzer Type, or the Double Whizzer Type (shown) and in sizes from 2'6" to 18'0" in diameter for various capacity requirements . . . also 10-inch Laboratory Separator.



Closed circuit arrangement: Separator classifies fine material and returns oversize to mill for regrinding.

SINCE 1887

THE RAYMOND *whizzer-equipped* Mechanical Air Separator provides a modern type classifying unit that is economically adapted for making the various grades of quality powdered materials, demanded in the chemical, food and process industries.

Whizzer Separation is effective, not only in maintaining product uniformity within close limits to meet exacting fineness specifications, but also for increasing overall output of the system . . . as much as 75% or more in closed circuit grinding operations.

You will find Raymond Whizzer Separators equally efficient for making consistent end products in the range of 50 mesh to 99.9% or better passing 325 mesh, or for dedusting a material to remove objectionable fines.

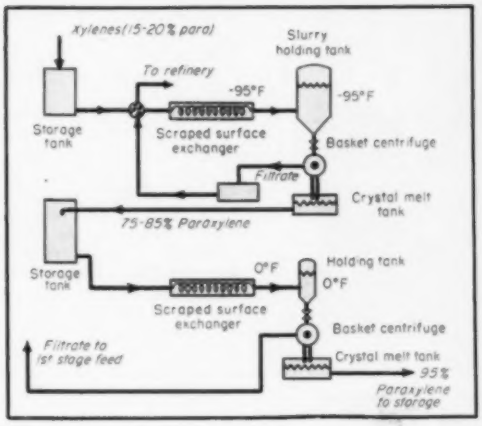
Whatever your problem, a Whizzer Separator offers you consistently uniform production and economical operation. *Write for detailed information.*

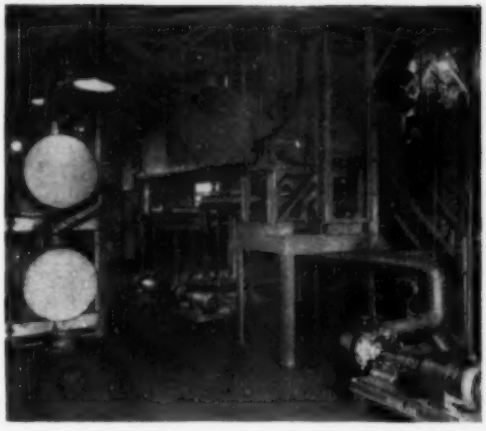
COMBUSTION ENGINEERING-SUPERHEATER, INC.

1311 North Branch St., Chicago 22, Illinois

Raymond
PULVERIZER DIVISION

Sales Offices in Principal Cities





Para Xylene Finds A Home

A one-time fringe chemical, para xylene has become the chief building block for Dacron. Here is how it is separated from hydroformed xylenes and purified.

In the synthesis of Dacron, para xylene is oxidized to terephthalic acid, which is esterified with ethylene glycol to give the new polyester fiber. When Du Pont decided to make Dacron, the hunt for para xylene was on. Unfortunately, at the time no commercial use for para xylene existed; none was being produced.

But plenty of mixed xylenes were being made. During the war, the tremendous need for toluene catapulted petroleum xylenes onto the chemical scene. To make toluene, hydroformers converted naphthenic hydrocarbons in the C_6-C_8 range into benzene, ethylbenzene, xylenes and toluene. After removal of the ortho isomer, the meta and para xylenes found considerable use in aviation gasoline.

However, recovering para xylene has offered a fair engineering challenge. Fractional crystallization is difficult and expensive. Recovery is not complete: Para, ortho and meta xylenes form a solid eutectic mixture at about −75 deg. F.

At its Baytown, Tex., refinery, Humble Oil & Refining Co. is now producing in a pilot plant (see cut) 10,000 to 20,000 lb. of p-xylene per month. With separation problems solved, processing procedures worked out, the company is planning commercial production.*

Construction of a new plant will start in a few months at Baytown; it should be completed by next spring. Capacity: 25 million pounds a year.

▶ **Separation**—Feed stock is pumped from storage through a precooler held at about −40 deg. F. The feed then passes through a scraped surface exchanger. Here the temperature is lowered to −95 deg. F. Ethylene is the cooling medium in the three-tube heat exchanger in the pilot plant.

Most of the p-xylene crystallizes in the exchanger. Additional crystallization occurs in the slurry holding tank held at −95 deg. F. Only about one half of the p-xylene is recoverable because of eutectics.

The holding tank serves also as a surge drum for the centrifuge charge. Crystals are discharged into a basket type continuous centrifuge, which is charged intermittently. The mother liquor drains from the crystals under the centrifugal force of 1,000 times gravity, and is returned to the refinery for further use.

Knife of the centrifuge rises automatically. Crystals are cut from the basket, fall through a chute, and discharge into the melt tank directly below. The crystals, which now contain 75 to 85 percent p-xylene, are melted and pumped to the second-stage feed storage. The melt tank is operated at 80 deg. F.

Next step, purification or re-crystallization, produces the 95 percent p-xylene product. Equipment here is similar to that of the initial step. However the capacities, with the exception of the centrifuge, need only be one-tenth as large. The first-stage mother liquor, which was returned to the refinery, is no longer present.

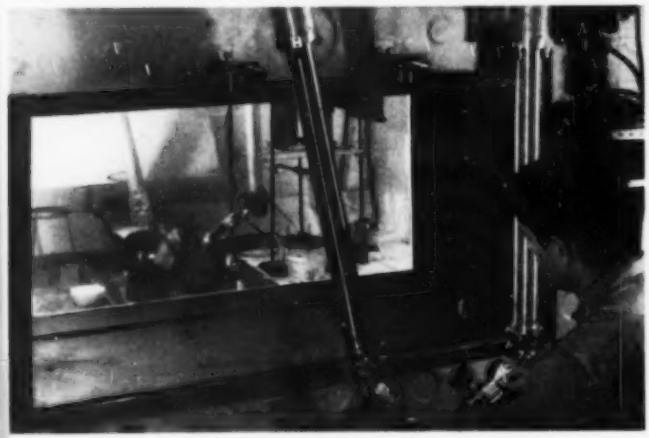
▶ **Purification**—From the melt tank, the p-xylene goes to intermediate storage. Concentrate is then crystallized in a scraped surface heat exchanger and holding tank held at 0 deg. F. (The refrigerant here is propane.) This tank serves both as a holding tank and surge drum. Slurry then passes into a basket-type continuous centrifuge.

Filtrate discharge contains from 40 to 50 percent p-xylene which is recycled to the first stage feed. By recycling filtrate all p-xylene charged to the second stage is ultimately recovered.

The melt tank operates at about 80 deg. F. From this tank the 95 percent p-xylene goes to storage. It will be shipped in tank cars equipped with steam coils to melt it for discharging, if necessary. The destination: the $33 million plant of Du Pont at Kinston, N. C.

* At present Oronite Chemical Co. is the only other producer.

RESEARCHERS use manipulators to carry on delicate work in these hot cells.



PORTHOLE, filled with liquid, allows worker to see behind concrete wall.

Hot Research by Remote Control

If you want to see something new in how to carry out research work, be sure to visit the Physics of Solids building at Oak Ridge National Laboratory in Tennessee.

There you can see research engineers standing before a 3-ft. thick concrete wall carrying out delicate work behind it by the adroit use of "mechanical hands." You'll probably get the strange feeling that here the men are robots and that the machines are men.

The whole setup, of course, is designed for carrying out research work with radioactive materials so dangerously "hot" that the researchers must be protected by elaborate means.

▶ **Seven Hot Cells**—Oak Ridge's Physics of Solids building has a bank of seven hot cells where neutron bombardment is used as a new tool to study solid states. A wall 3 ft. thick and made of high-density concrete separates the worker from his work.

Each cell has a porthole, also 3 ft. thick, through which he can watch what happens inside the flood-lighted work areas of the cells. These are made of two thick glass plates separated by a dense transparent liquid.

All handling of equipment and materials inside the cells is done by remote-control master-slave and rectilinear manipulators (see cuts) developed at Oak Ridge.

One objection to the motor-driven manipulator compared to the direct-acting pantograph type is that the operator lacks "feel." The rectilinear manipulator with feed-back gives him this important "touch perception." The human-like hands in the cell respond to slight pressure or movement of the operator's hands on the other side of the wall.

These manipulators have now been perfected to the point that a researcher can use them with ease and speed to carry out almost any operation: turn a valve, operate machine tools, make microscopic examinations, manipulate an analytical balance, handle chemicals, use delicate laboratory apparatus.

When completed, this new building at Oak Ridge was the only one in the nation with such versatile equipment for remote control handling of radioactive materials. It is operated by Carbide & Carbon Chemicals Corp.

Stanolind Oil Putting In New Sulphur Recovery Units

Feed gas at the North Cowden gasoline plant of Stanolind Oil & Gas Co. contains 58 percent hydrogen sulphide. Here at North Cowden, 15 miles northwest of Odessa, Tex., Stanolind will build a sulphur recovery unit with a capacity of 17.7 long tons a day.

Girdler Corp., which will do the contracting work, plans to have things running by early 1953.

At Sundown, Tex., Fluor Corp. has started construction of a recovery unit at Stanolind's Slaughter plant. Capacity: 49 long tons a day.

Sorghum Scarcity Hurts Corn Products Expansion

Because of drought conditions in Texas, high price of grain sorghum may continue for another year. As a result, Corn Products Refining Co. will not expand its Bluebonnet plant at Corpus Christi, Tex.

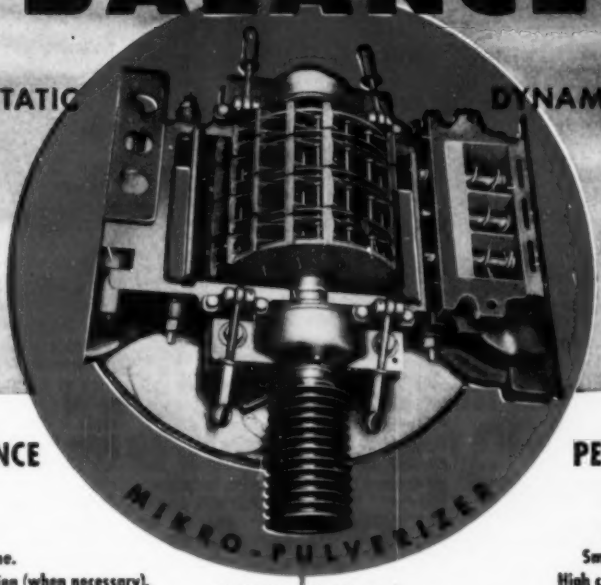
The company located at Corpus Christi to be near the supply of sorghum. Cost of shipping right now from other areas, added to the already high price of grain, makes production cost high. "The Bluebonnet plant is operating on a nonprofit basis," Vice-president W. T. Brady states.

But the company is optimistic.

"We are not in business on a short-term policy. Business in general is only fair at present, but that in no way changes our opinions or projections on a long-term basis," Brady comments.

PERFECT BALANCE

STATIC DYNAMIC



Typical inside view of a MIKRO PULVERIZER

What PERFECT BALANCE Does:

- Eliminates vibration.
- Lengthens life of machine.
- Permits ceiling suspension (when necessary).

What PERFECT BALANCE Gives:

- Flexibility in installation
- Smoother machine operation
- High constant rate of production

Long Life Span

Many of our first MIKRO-PULVERIZERS, built more than a quarter century ago, are still in active service. Perfect balancing of all moving parts has had much to do with this longevity.

Catalog Tells All

If you are presently confronted with a problem concerned with pulverizing or granulation of materials, write today for a copy of the MIKRO illustrated catalog.

No. 2DH MIKRO PULVERIZER

The MIKRO PLAN for Processing Efficiency

This plan has enabled both large and small manufacturers of diverse products to improve quality of product, increase volume and cut both maintenance and production costs. It can also be helpful to you if you have a problem in pulverizing or granulating materials. Just let us know what your problem is and the three-way MIKRO-PLAN will start to work for you. Our engineers will advise the best method and equipment to solve your problem.

PULVERIZING MACHINERY COMPANY
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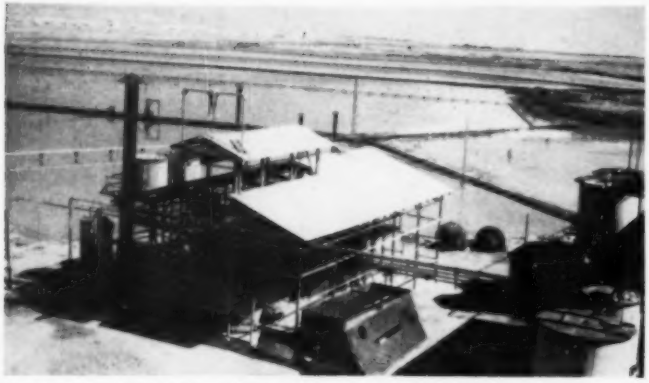
PRESERVE OUR HERITAGE: FAITH, FREEDOM AND INCENTIVE

MIKRO-PULVERIZER (FINE) -ATOMIZER (ULTRA FINE)
Reg. U. S. Pat. Off.
Also Makers of the MIKRO-COLLECTOR



IN ISRAEL: Small plants, undeveloped resources, inadequate transportation.

Israeli Face Chemical Problems

Valuable mineral deposits spur the hard fight Israel's CPI is putting up against war-caused disorganization, and a lack of transportation facilities, sweet water and sulphuric.

Abundant natural resources such as potash, phosphates, Dead Sea chemicals, manganese and feldspar give Israel an undeniable equity in a thriving chemical industry. Until recently, however, movement toward that goal seemed to be one step backward for every two forward.

But there's been healthy activity of late which indicates that Israel's chemical industry may be building up some real momentum.

Here are a few recent samples: Reichhold Chemicals teams up with Israeli investors to turn out a complete line of synthetic resins there; a national company scheduled for cellulose production; a 12,500-ton paper mill of American-Israel Mills to be completed this year; a large insecticide plant to be operated by American interests on local salt and benzene.

Best of all is the news that Israel's oldest large-scale chemical venture, Palestine Potash Ltd., plans to reopen its plant at the southern end of the Dead Sea by April 1953.

Before the Arab-Jewish War of 1948, Palestine Potash had built two inter-connected plants at opposite ends of the sea. During the fighting, the northern one was completely destroyed. The southern one, though still intact, has been paralyzed by lack of capital for reorganization (from a British to an Israeli company), transportation possibilities and sweet water. The plant is still capable of producing 100,000 tons of potash yearly and now has enough raw material (carnallite) for over a year's output.

▶ **Obstacles Attacked** – Now Palestine Potash has been semi-nationalized, 51 percent of the shares going to the government, the remainder to private interests. The government will invest $1.7 million in the firm and has allotted to it $2.5 million out of an Import-Export Bank loan. Also Palestine Economic Corp. of New York has promised a loan of $1 million. The new enterprise will enjoy a monopoly on the rights to exploit the chemical wealth of the Dead Sea.

Part of the plant's equipment, pipelines and railway are damaged. About 2,500 tons of semi-refined potash are lying in canals and evaporation pans. Shipments have to wait the completion of the new Beersheva-to-S'dom road late this spring. Trucks will then haul potash from S'dom to Migdal Ascalaon where there is a railroad to Haifa's port.

▶ **Phosphates Harnessed**–In addition to potash, another mineral receiving industrial attention is phosphates. Work began on newly discovered deposits in the northern Negev area in June of last year. The deposits are soft, homogenous and laid in continuous strata; they can be mined by the economical open-pit method. Even under the present bad conditions, 100 to 200 tons are produced daily.

Phosphate rock is shipped at high cost by truck and rail to Haifa where it is made into superphosphates by Israel Fertilizers, Ltd. When exploitation of the deposits starts on a larger scale, it is planned to enrich the mineral on the spot to save shipping space and costs. A branch railway to the mine is under study.

The Negev phosphates deposits should not only cover Israel's needs for many years to come, but even allow a sizable export to other countries.

▶ **Sulphur's Poor**–Sulphuric acid, indispensable to the chemical industry, is critically short in Israel. At the present time, the country's chief producer of sulphuric acid is the Fertilizer & Chemical Co., Ltd., of Haifa.

Due to troubles in getting raw material, this company produces less than 20 tons of acid per day, using imported natural sulphur. The needs of the country are placed at 30 tons or more daily.

The government therefore decided to regulate use and distribution of sulphur. Some of the sulphuric acid previously used for the manufacture of phosphate fertilizers was placed at the disposal of various industries where lack of it had become a critical bottleneck. Even so some plants, such as a brand-new detergent factory on the Haifa bay, are often unable to work for lack of acid.

Sulphuric producers are now studying the possibility of shifting to pyrites instead of natural raw sulphur. Pyrites could possibly be obtained more easily and nearer from Cyprus, Spain or N. Africa. Conversion of Fertilizer & Chemical's plant would take a year and cost about $1 million. Meanwhile, the budding Israeli industry will have to count on a severe shortage of acid for some time to come.

▶ **Mineral Rich** – But the picture brightens considerably after an inventory of the country's potential resources in chemicals.

First, there are the Dead Sea deposits, still to a large extent under Israeli control. At the time of the British Mandate these deposits had been reliably estimated (in millions of tons) as follows: magnesium chloride, 22; sodium chloride, 11; calcium chloride, 6; potassium chloride, 2; magnesium bromide, 1.

Secondly, there are the large deposits of phosphates suitable for fertilizers, as well as of bituminous limestone, in the Judean hills west of the Dead Sea.

Thirdly, deposits of manganese, barytes and feldspar have been found in the large, barren and practically uninhabited Negev Desert in the south. These raw materials may well be exploited in the future.

materials and component parts from other ing the months ahead."

BROWN & ROOT, TOPS IN TOTAL CONSTRUCTION IN TEXAS

AUSTIN, Jan. 2 (AP) — Despite government controls on building, Texas construction contracts passed the billion dollar mark for the second time in history in 1951 and set an all-time record of $1,076,252,036 . . . .

The record-breaking overall total was reported today by Hanford Reed, editor of "Texas Contractor," building trade journal.

Numerous large single projects were put under contract in 1951 . . . . The Lone Star steel plant which was awarded to Brown & Root, Inc., of Houston was in excess of $70,000,000 . . . .

Brown & Root led all contractors in dollar value. "Texas Contractor" estimated the firm won contracts totaling close to $200,000,000.00.

"A turning point in Texas' post-war construction boom was reached in July 1951," Reed said in an editorial for the Jan. 1 issue. "Up to mid-year, the construction industry as a whole, in common with many other segments of Texas economy, had been operating at levels never before reached in history . . . ."

Reed predicted the dollar value of Texas construction would continue high because of new projects necessary to the defense effort.

Inside Red China: Army, Regime

Brown & Root construction men are busy over the globe, building an astounding variety of heavy industrial plants and facilities. Wherever they are . . . Guam, Mexico, Canada, the Caribbean . . . Brown & Root jobs are tops in workmanship, speed, and economy. An inquiry will put our staff at your disposal.

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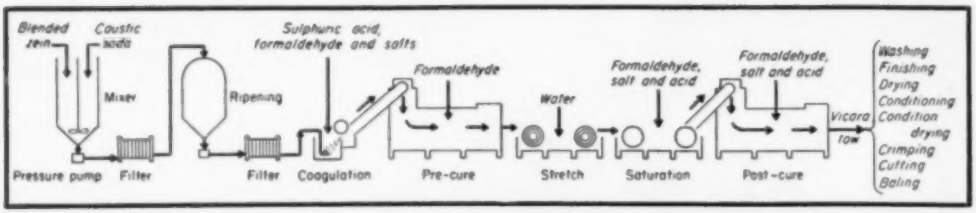

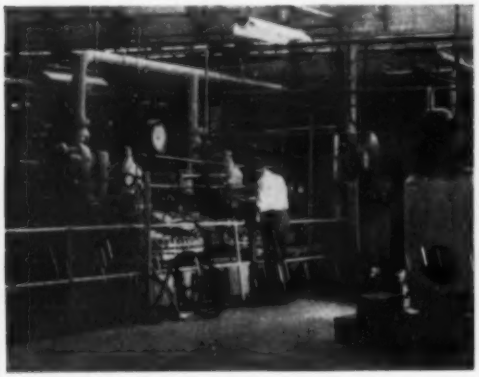

SPIN solution is made here so that . . .

TOW becomes a quality blending fiber.

Close Process Control Puts Vicara Over

Virginia-Carolina has put over its protein-base fiber through rigid control of process, product and markets. Output target is now 50,000,000 pounds a year.

Chances are you'll soon be wearing a pair of socks or some item of clothing of man-made protein fibers blended with wool or other materials.

For Vicara—Virginia-Carolina Chemical Corp's protein-base textile fiber—has now won a solid reputation as "the fiber that improves the blend." And output is being stepped up to meet, for the first time, a strong textile demand.

▶**Output Goes Up**—Early this year Virginia-Carolina brought in its third Vicara line at its Taftville, Conn., plant. This jacks up total capacity to about 12 million pounds a year.

But the end isn't yet in sight. By 1954, V-C plans to hike Taftville's output to 20 million pounds a year. Then (unless the zein raw material again becomes a temporary bottleneck) another plant will probably be put up to produce Vicara.

Thus output of Vicara may very well hit 50 million pounds yearly by 1955—about 10 percent of the estimated U.S. output of all non-rayon man-made textile fibers by that year.

Some people close to the textile industry estimate Vicara's near-future potential at nearer 100 million pounds a year. This is a far cry from the 2.4-million-pound capacity of 1949, the year that V-C put its first line on stream at Taftville.

Right now, Vicara's the only protein-base man-made textile fiber produced commercially in the U.S.*

And many people look upon it as the first really successful one, too, for previous protein-base textile fibers had won—and lost—their reputations largely as "substitute" materials.

Basic work on the process was done by Agriculture's Northern Regional Research Laboratory. Virginia-Carolina began its research in 1939 and put its process into pilot plant in late 1947. It bought the Connecticut plant from National Dairy Products in 1948, had it in commercial operation a year later.

▶**Close Control Does It**—Vicara's biggest achievement has been to overcome the textile industry's long-standing prejudice that protein-base fibers are substitutes.

* A small tonnage of protein fibers for industrial filters is now being turned out by another U.S. producer. And last year England came out with its Ardil, a textile fiber made from peanuts.

How Vicara Compares With Wool

	Wool	Vicara [1]
Price of staple, lb	$1.77 [2]	$1.00
Tensile strength, gm./den	1.0–1.7	1.1–1.2
Elongation, percent	25–35	30–35
Elastic recovery	0.99 @ 2%	0.995 @ 4%
Strength, M psi	20–29	17–19
Stiffness, g./d	3.9	2.8
Abrasion resistance [3]	0.25	0.18
Water absorbency, percent [4]	21.9	25
Effect of heat	decomp. @ 130 °C.	Weakens @ 178 °C.
Effect of age	little	slight
Effect of sun	weakens	slight
Effect of acids [5]	resist.	resist.
Effect of alkalis [6]	suscept.	resist.
Organic solvents	resist.	resist.
Dyeability	good	good
Resist. to moths	none	high
Resist. to mildew	good	high

[1] On 10 percent moisture regain basis. [2] Quotation for wool as of March 7, 1952. [3] As gm./den. divided by den./cm. [4] At 90% relative humidity. [5] Conc. acids at room temperature. [6] Weak alkalis at room temperature.

Lubrication problems?

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Many uses for this stable, high-boiling ester are based on its excellent lubricating and plasticizing properties. The few examples listed give an idea of the wide range of products which utilize the lubricating and other properties of Butyl Stearate:

- Strippable coatings to protect metal articles
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- Plastic articles and films
- Abrasion- and water-resistant finishes
- Non-staining lubricant for rolling foil
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- Special lubricants for mechanical equipment

Butyl Stearate is an important ingredient, too, in such products as lipsticks, shaving creams, vanishing creams, mimeograph stencils, and carbon papers.

Write today on your company letterhead for literature and a free sample.

SPECIFICATIONS

Specific Gravity @ 25°C./25°C:	0.856-0.861
Acidity as Stearic acid:	0.5% max.
Color:	Water-white
Water:	No turbidity when one volume is mixed with 19 volumes of 60° Be' gasoline at 20°C

PROPERTIES OF COMMERCIAL-GRADE MATERIAL

Molecular Weight	340-58 (calc.)
Density @ 20°C:	0.858 g/m l, or 7.14 lbs/gal.
@ 25°C:	0.855 g/ml, or 7.13 lbs/gal.
Coefficient of Cubical Expansion:	0.000 46 per 1°F. 0.000 83 per 1°C.
Distillation Range @ 25 mm of Mercury:	220°C—225°C
Melting Point:	19°C, approx.
Heat of Fusion:	40 cal/g, approx.
Refractive Index, n_D @ 20°C:	1.444
@ 25°C:	1.442
Dielectric Constant @ 30°C:	3.12
Odor:	Practically odorless
Flash Point, Cleveland Open Cup:	374°F
Solubility @ 25°C:	Approximately 0.2 ml Butyl Stearate soluble in 100 ml water. Approximately 0.03 ml water soluble in 100 ml Butyl Stearate

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CHECK YOUR Sulfur Recovery

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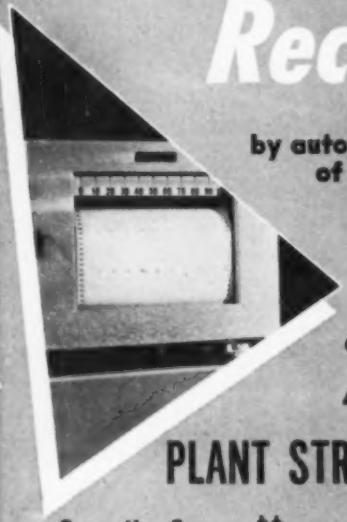

with this continuously recording PLANT STREAM ANALYZER

$ up the flue = $$ gone cloud-hunting . . . An accurate, continuous check on the percentage of SO_2 present in the vent gas is a simple first step toward reducing this needless loss of sulfur. In this application, this continuously recording Plant Stream Analyzer has a sensitivity of 0.01% concentration using a full-scale deflection of 1% on the recording indicator. Strong absorption of infrared by SO_2 assures high sensitivity to this compound in the dry state.

This is only one of the countless applications of this sensitive, reliable, sturdy instrument in control situations where the concentration of an infrared absorber in the process stream is a critical index of operation. In many cases, the adaptation of the instrument for automatic control of the process itself is realizing huge additional savings.

▶ WRITE TODAY FOR BULLETIN 36.

PROCESS CONTROLS

a division of Baird Associates, Inc.

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This has been done through Virginia-Carolina's set policy of rigid controls: process, product and uses . . . "the real secret of our success with Vicara," says Vice-President Edwin Cox.

The process is rigidly controlled from the blending and testing of the zein raw material to the finishing of the fiber itself. This, in turn, gives a high-quality product with characteristics that can be controlled, tailored for specific uses and duplicated at will.

To be sure that Vicara is always used properly, V-C keeps close tabs on where it goes. Each new blend must pass rigid tests before V-C will sell Vicara in commercial quantities to the fabric manufacturer. This insures that every use of Vicara gives a product that's tops in quality.

▶ **Process Uses Zein**—Process used at Taftville is based on zein from Corn Products Refining Co. and other producers. To supply Vicara's needs, now the largest single outlet for this by-product of the corn starch industry, several new zein units are being put up. These will be able to turn out some 30 million pounds of zein annually and will eliminate the temporary raw material bottleneck.

Zein was picked as the protein raw material because it is available in large quantities, is standardized in quality and has a polar molecular structure. Other proteins can be used, although the Vicara process would have to be modified a bit.

Zein is extracted from corn protein with 70 percent isopropyl alcohol. It arrives at Taftville as a pale yellow, finely divided powder where it is screened and blended in ribbon mixers.

This blending guarantees exact uniformity of the raw material. The zein molecule is highly complex (with a molecular weight of 40,000) and has 19 amino acid groups, each with varying reactive characteristics. Blending offsets any random averages that may occur. Each blend is then tested for its gelling rate, sensitivity to electrolytes and other properties that determine its fiber-forming performance.

▶ **Uncoil the Molecules**—Next step is to prepare the spin solution. Here the long and globular protein molecules, curled up in their natural state, must be uncoiled.

Spin solution is made by dispersing the zein in dilute caustic soda. It is then pressure filtered to take out traces of any solid impurities. The solution must also be completely free of air or gas bubbles since these would "break the chain." A delusterant may be added at this stage. It is then put through a "ripening" step.

As the spin solution ripens the intramolecular bonds binding the amino acid groups are broken and the tangled chains of the molecule begin to straighten out. The untangled molecules then interact through secondary valence forces and the solution becomes viscous.

Ripening is continued until the molecular unfolding and interaction are properly balanced. Some amorphous groups must be kept within the molecules. Otherwise the final fiber may lack strength or high-range elasticity.

Chemical engineering operations in this critical stage involve controlled reactions in jacketed vessels, precise control of temperature and time, pressure filtration, curing, de-aeration and the controlled pumping of high-viscosity liquids.

The spin solution—now viscous and heavy—is forced through platinum–rhodium spinnerettes (each with about 5,000 holes) into a precipitating bath. This contains acid, formaldehyde and various salts that regenerate the protein as filaments. The uncoiled molecules have now been loosely tied together into bundles through cross-linkage by the use of salts in the bath as catalysts, electrolytes and tanning agents.

▶ **Fix Them in Place**—Up to the coagulation stage the Vicara process is fundamentally different from that of most other man-made fibers. Now it begins to resemble other fiber-forming processes.

The filaments are strong enough immediately after coagulation to be lifted from the bath as a composite tow with as many as 270,000 individual filaments. This tow is conveyed to the pre-curing tanks and given a mild formaldehyde cure.

This cure toughens the fibers so that they can take the orientation stretch that follows. The fibers are in a swollen state and evidently the formaldehyde reaction with the protein molecule is of the methylol type. Pre-curing must be carefully controlled so that the fibers have their desirable properties after stretching.

The next step is the orientation stretching, which is carried out in several stages. Pre-cured plastic filaments pass as a continuous tow to the stretching units where the reactive groups within the molecules are brought closer together and cross linking continues. The degree of orientation given to the molecules here has a lot to do with the final character of the fibers. It's important to keep the amorphous chains that act as buffers to those of high crystallinity, for these give Vicara its wool-like "springiness."

Stretched fibers move to the post-

DUSTUBE

recovers 4 tons of phosphate dust per day **for**

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In the phosphorous processing plant of Monsanto Chemical Company, dust arising from the handling of sintered phosphate ores, Florida phosphate rock and coke is effectively controlled with a Dustube Collector.

Recovering 4 tons of dust per day which is returned to the sintering operation, the Dustube noted for its many cost saving features plus its high collecting efficiency, cleaned up extremely dusty material handling operations.

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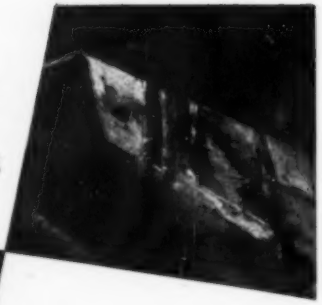

WITHOUT DOWNTIME for CLEANING or REPAIRS

at the Lycoming Spencer Division Avco Corp., Williamsport, Pa.

The only time this Platecoil was removed in over a year at Lycoming Spencer was to take its picture. The single 22" x 23" Platecoil has heated a 100-gallon Parkerizing tank, in daily use, *without downtime.* Built of Electro-polished Stainless Steel, the Platecoil has required *no cleaning or repairs.* Any deposit that builds up on the coil during the course of operation is "shocked off" when the steam pressure is dropped in the coil.

Notice how easy it is to lift the Platecoil out of the tank when the time comes that it does have to be cleaned, repaired or replaced. There are just two connections to loosen and both are outside the solution. The Platecoil merely is lifted out of the tank and replaced with little or no delay in production.

Platecoils have other advantages, too. They have about twice the heating area for a given space than can be obtained with pipe coils. Thus smaller size Platecoils can be used to save initial cost, tank space and handling time.

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PLATECOIL
KOLD-HOLD MFG. CO.
LANSING 4, MICHIGAN

cure chambers where they are saturated with the post-cure solution while under tension. Here they are substantially dehydrated and their cross linkages set. The post-cure solution contains formaldehyde and acid saturated with sodium chloride.

Since post-curing "locks" the molecules in their oriented state and completes the curing operations, the saturated fibers can now be relaxed without shrinking. They are then practically impervious to the effects of water, alkali, acid and organic solvents.

▶ **Sixty Washings**—The tow now goes to the washers and dryers. It is given 60 consecutive washings and squeezings before cutting and baling.

Drying is done in steam-heated ovens with continuous stainless steel conveyor belts. After an initial drying, the fibers are humidified and then dried to a constant moisture content.

The dried tow can be passed through a conventional stuffing box to develop crimp and then cut into staple. All staple fiber is shipped in bales of 300-1,000 lb. each. Continuous tow is usually boxed in cartons of 125 lb. each.

Protein molecules travel more than seven miles from the time they enter the plant as zein until they leave it as Vicara staple or tow.

▶ **Improves the Blend** – Vicara has quickly won a reputation among textile people as "the fiber that improves the blend." And Virginia-Carolina is quick to point out that Vicara complements rather than competes with wool and other fibers.

As one fabric manufacturer put it recently: "I don't use Vicara as a substitute for wool or nylon—I use it because it allows me to put out a better product at a lower cost."

Vicara is more closely related to wool in chemical structure and properties than any other man-made fiber (see table).

Some of Vicara's outstanding properties include a soft, cashmere-like hand; warmth equal to wool; high absorbtiveness; resistance to mildew and months; high wrinkle recovery and resistance to mussing; strength similar to wool; high resistance to shrinkage; resistance to pilling and fraying; good dyeability; easy spinnability. It has never been known to cause an allergy.

Vicara is being blended with all of the natural and man-made fibers. A 50-50 combination with nylon in men's socks, for instance, combines the strength and abrasion resistance of nylon with the absorbability, resilience and softness of Vicara.

In a 60-40 blend of cashmere and Vicara, sweaters have been knitted

which have the hand of 100 percent cashmere. Vicara's resistance to shrinkage lends a great deal of stability plus longer wear-life, to say nothing of the economy of using 40 percent Vicara in the blend.

In cotton underwear, Vicara gives a warm, long-wearing, non-itching blend. And dimensional stability is greatly improved. In combination with wool and/or rayon, fabrics are being made which have all the desirable qualities of these fibers plus Vicara's hand, feel and drape, wrinkle recovery, mussing resistance and other properties.

Vicara's resistance to chemical action and its high thermal stability make it a natural for use in industrial fabrics.

Monsanto's to Supply Resins for West Coast

Monsanto's Plastics Division plant at Springfield, Mass., has supplied butylated melamine and urea resins to the West Coast for several years. A new plant, completed last month by them, at Santa Clara, Calif., will now be a regional source of supply for these resins.

The resins, marketed under the trade name Resimene, are used by the paint industry in the manufacture of fast-drying, durable surface coatings for appliances and furniture.

CONVENTION CALENDAR

Association of Consulting Chemists & Chemical Engineers, general symposium, Belmont Plaza Hotel, New York, April 22.

American Oil Chemists Society, spring meeting, Shamrock Hotel, Houston, April 28-30.

American Drug Manufacturers Association, annual meeting, Homestead Hotel, Hot Springs, Va., April 28-May 1.

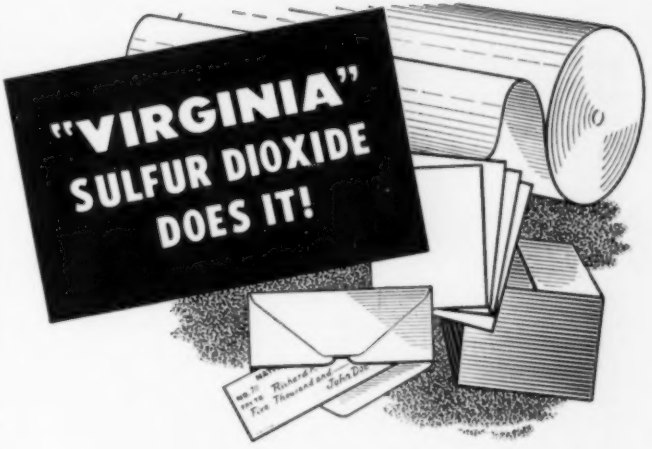
Electrochemical Society, spring meeting, Benjamin Franklin Hotel, Philadelphia, May 4-8.

National Air Pollution Symposium, Huntington Hotel, Pasadena, Calif., May 5-6.

American Institute of Chemical Engineers, French Lick Springs Hotel, French Lick, Ind., May 11-14.

American Drug Manufacturers Association, production and engineering section, spring meeting, Homestead Hotel, Hot Springs, Va., May 14-15.

25th International Congress of Industrial Chemistry and ACHEMA X, the 10th exhibition of chemical apparatus and equipment, sponsored by DECHEMA and Societe de Chimie Industrielle, Frankfurt on Main, Germany, May 18-25.



paper profits pay off

There are at least four good reasons for using "Virginia" Liquid Sulfur Dioxide in paper pulp processing: (1) practically 100 percent pure—relatively small quantities required; (2) introduces no impurities that are hard to remove from end product; (3) easy to transport, store, handle; (4) pH control, manual or automatic, can be easily maintained with a high degree of accuracy.

All this adds up to improved production. We engineer the storage, staging and flow control facilities as well as supply the SO_2. It's typical of the combination of technical know-how and superior "Virginia" SO_2 which 40 diversified industries have used to their profit in the past 30 years.

You may not manufacture paper, but it's likely that versatile "Virginia" SO_2 has a place in your products or processes—as a preservative, pH control, antichlor, or reducing, bleaching or neutralizing agent. We'd like to put our SO_2 to work for you. A request for our booklet (on your business letterhead) will start the ball rolling.

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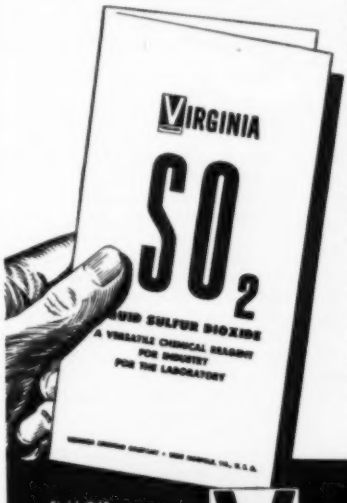

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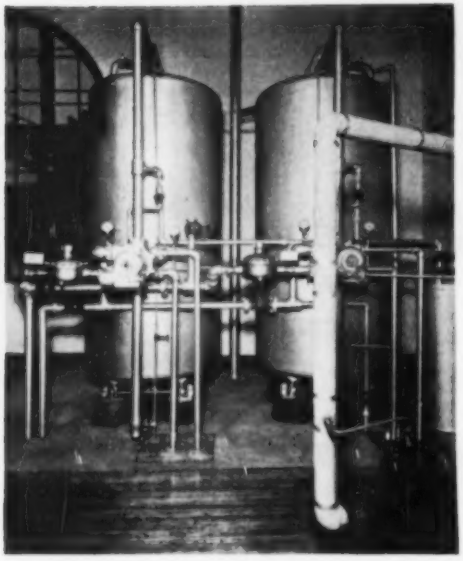
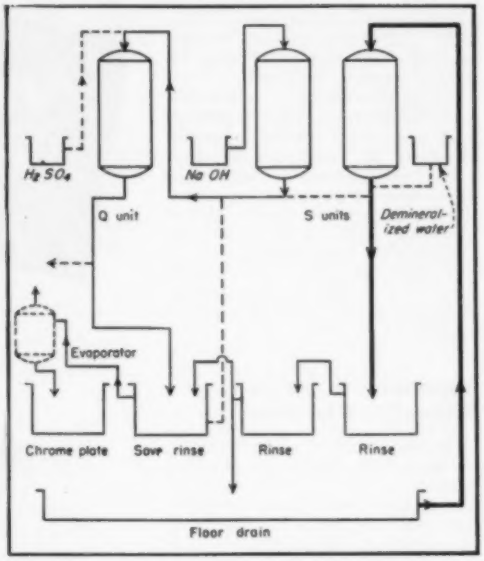


UNITS contain ion exchange resins which recover chromates.



PROCESS: a plating operation designed to prevent waste.

Waste Chromate Ions Recovered

Synthetic ion exchange resins are making news again. This time: from anodizing and plating baths they recover chromate ions—and dollars—from the drain.

As every economy-minded engineer knows only too painfully, waste disposal is usually a problem with a double array of thorns: you have to pay plenty to throw away valuable and expensive material because it's contaminated.

So when you can recover and reuse costly material instead of polluting streams with it, or spending a lot of money to have it decontaminated and hauled away you're ahead on two counts.

That's just what one company did with valuable chromates used in anodizing baths. The secret: ion exchange.

Here's how it works:

When you use chromic acid in a bath for anodizing aluminum, plating chromium or stripping copper, the acid becomes contaminated with metallic cations and soon needs replacement.

Actually the chromate reacts with the metal surface dissolving some of the metal and producing trivalent chromium from the hexavalent form. Sometimes this reaction is necessary as in the case of bright dipping or copper stripping, but usually it is an unfortunate side reaction. In all cases, it consumes the acid, produces a chromate salt which (1) cannot be reused, (2) is highly concentrated, toxic and (3) is tough to dispose of.

▶ **Resin Recovery**—A new installation at an aircraft plant in the New York area has eliminated the problem with (1) a cation exchanger which removes metallic cations from the strong chromic acid anodizing solution and (2) an anion exchanger that recovers the chromate from the dilute rinse solutions. The installation is based on Permutit Co.'s synthetic ion exchange resins Q and S. The resins exchange one ion in solution for another by means of an insoluble granular material which can operate in a reversible manner.

The anodizing bath is operated at a pH between 0.7 and 0.9 and 50-70 gpl. of CrO_3. All that is necessary is to withdraw a portion of the bath each day and pass it through a bed of the high capacity cation exchanger, removing all of the aluminum and other metallic cations and substituting hydrogen cations. The effluent, with a very low pH, returns and mixes with the remainder of the chrome bath, thereby lowering both the over-all metallic content and the pH. This treatment does not interfere with anodizing which need not be interrupted.

The cation unit was sized so that operation once a day maintains the metals at a fair level. Experience has shown that the bath pH can be maintained within very close limits and that very little CrO_3 must be added. Since the permissible metallic concentration is high in the anodizing tank, only a small fraction of the bath need be treated at any one time. Treatment usually takes less than an hour. Exhausted resin Q is regenerated with sulphuric acid, which carries the metallic ions to waste.

▶ **How Anion Exchanger Works**—Resin S is used to recover chromate from the save rinse tank. Such a tank will save from 60 to 90 percent of the chromate being dragged from the treatment tank. Remaining chromate, though, is still troublesome and requires treatment. The rinse water is sent through a bed of the anion exchanger which substitutes hydroxyl ions for chromate ions. Here's where the ion exchange resin offers an additional advantage. Since the resins can also act as a water demineralizer, the rinse tank is initially made up with demineralized water. So when chromate ions are removed, demineralized water is once again returned to the

system with no further treatment. Where a hot rinse is used, most of the heat is conserved too.

When the S unit is exhausted with chromate, flow is either halted or shifted to an alternate unit and the resin is regenerated with caustic.

Based on a full year's operation of the ion exchange system the following advantages are claimed:

- When compared with conventional disposal equipment, initial and installation costs are reduced 50 percent.
- Operating costs are lowered 75 percent.
- About 80 percent less floor space is needed.
- Consumption of scarce materials is reduced 90 percent.
- Water and steam consumption are reduced 85 percent.
- Better plating and anodizing efficiency.
- A better finished product is assured.

Here is a tabulation of actual cash saving of recovery over disposal:

	Disposal	Recovery
Value, lost CrO_3 (100 lb. per day)	$33	$3
Equipment amortization (includes ion exchange replacement)	6	9
Chemical cost	20	5
Water and Heat	4	0
Total	$63	$17

Esso Plans Additional Expansion at Baton Rouge

Six months ago Esso Standard Oil Co. announced plans for a $35 million expansion at its Baton Rouge refinery. Not satisfied, it has now announced plans for an additional $16 million project.

Further extension, which should be completed in two years, will include new distillation and expansion of fluid catalytic cracking facilities. Equipment will also be set up for expansion of chemical treating, blending and shipping facilities.

Units now under constructon will increase the refinery's output of butadiene, synthetic alcohols and benzene.

Reynolds Metals to Build Arkansas Aluminum Plant

Reynolds Metals Co. has picked Gum Spring, Ark., for the site of its new reduction plant. The $30 million plant will turn out 55,000 tons of aluminum a year. Construction, which will start shortly, should wind up early in 1953. Construction includes an electrode plant to supply the potlines, an office building and laboratory.

Seeing more than Argus with the DIAMOND "UTILISCOPE"

(WIRED TELEVISION)

Argus, according to Greek mythology, had a hundred eyes, not all of which ever slept at once. He'd have been ideal for watching many industrial operations except that he couldn't see around corners, through walls, sit close to a potential explosion or look inside a furnace.

The Diamond "Utiliscope" (Wired Television) is much better than Argus with all his hundred eyes. The "eye" or camera is connected to the viewing screen by cable, so the "eye" can be practically anywhere . . . no matter how remote, dangerous, or difficult. Multiple "eyes" to any number are available just by adding more cameras and viewers. The "eyes" may be scattered all over a big plant, and all the images brought before one operator. Argus couldn't approach that.

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If you have any operation too remote, dangerous or inaccessible to observe directly . . . or if you need to have a single observer watch a number of widely scattered operations to assure their coordination, investigate the "Utiliscope." Write for Bulletin 1025.

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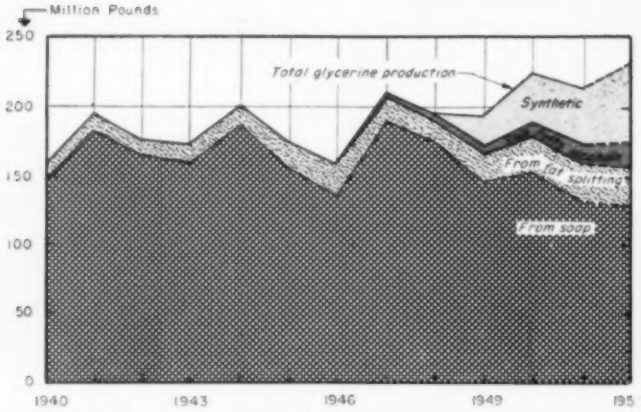

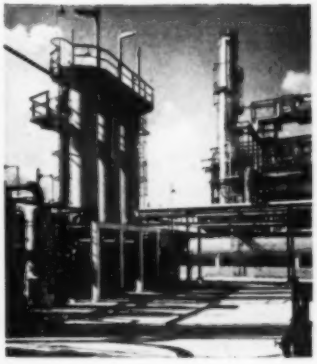

GLYCERINE OUTPUT from soap sags, but other natural sources take up slack, and Shell makes more synthetic at Houston.

Glycerine Producers Challenged

Even as increased synthetic capacity augments production of glycerine from natural sources, other polyhydric alcohols invade such ripe markets as alkyds.

Synthetic glycerine production is creeping up on output of natural. Shell Chemical Corp., sole U. S. producer of synthetic, has just expanded capacity of its glycerine plant at Houston, Tex., by 50 percent. But the competition between synthetic and natural glycerine is mild compared to that glycerine is facing from other polyhydric alcohols.

This year, synthetic glycerine will account for 55 million pounds of the estimated total U. S. production of 225 million pounds of glycerine. All of the synthetic will come from the Houston plant of Shell Chemical. Producers of fatty acids and fatty alcohols will turn out from 30 to 35 million pounds of glycerine, and soap makers will produce 135 to 140 million pounds.

Shell has streamlined its process for making synthetic glycerine, eliminating bottlenecks and installing some new equipment. Thus output has been stepped up without a major plant expansion.

When it first went on stream in the fall of 1948 Shell's plant could produce 36 million pounds per year. That rate has been steadily inched up, however, so that in 1951 it turned out 40 million pounds. As a result of the recent streamlining, the plant can now produce 55 million pounds a year or slightly better if pushed.

▶ **Making Synthetic**—Shell makes its synthetic glycerine by chlorinating propylene at upwards of 500 deg. C., then converting the allyl chloride to crude glycerine, which is concentrated, desalted and purified. Low-cost allyl chloride is Shell's key to low-cost glycerine.

Cracked gases containing propylene are piped to the plant from the neighboring refinery of Shell Oil Co. Propylene is separated and purified to avoid production of unwanted byproducts during glycerine synthesis. Liquid chlorine is piped in from Diamond Alkali's electrolytic plant.

Getting chlorine into propylene by direct substitution without attacking the more reactive double bond is a ticklish business. Shell does it by going to temperatures higher than ever before used—close to 600 deg. C. Shell engineers carefully control the highly exothermic reaction, and keep watchful eyes on temperature and pressure of the reactants. Propylene is raised from 40 to 260 psi. by 1,000-hp. compressor in allyl chloride production.

After purification, allyl chloride is converted to crude glycerine. Shell chlorohydrinates allyl chloride or allyl alcohol, then hydrolyzes the chlorohydrins to crude glycerine.

One way that Shell gets the mono- and dichlorohydrin is by reacting pure allyl chloride with hypochlorous acid. Another way is by reacting allyl chloride with an alkali in the presence of a cuprous chloride catalyst to get allyl alcohol, then chlorohydrinating the alcohol with hypochlorous acid. Next, the chlorohydrins are hydrolyzed with caustic soda. Crude glycerine emerges from the synthesis phase as a dilute water solution containing sodium chloride.

Concentration, desalting and purification are the final steps in the synthetic glycerine process. Crude solution is first pumped to multiple-effect evaporators, and from the last stage is withdrawn as a concentrated glycerine-salt slurry. This slurry goes to a settling tank from which glycerine concentrate is removed for final desalting and concentrating in a system of evaporators under reduced pressure. With the last traces of salt gone, the glycerine is finally purified by vacuum distillation. Product glycerine, more than 99 percent pure, is pumped to nickel-clad steel storage tanks until shipped either in drums or in Shell's glass fiber-insulated 8,000-gal. aluminum tank cars.

▶ **Deionizing Natural**—While Shell has been expanding synthetic glycerine capacity the producers of natural glycerine have not been napping. Three plants are now purifying glycerine by a new ion exchange process developed by Illinois Water Treatment Co. At least two others plan to do so.

In the deionizing process, glycerine solution, anywhere from very dilute to 40 percent by weight, passes through a series of pressure vessels containing ion exchange resins. Dissolved salts, acids and bases, as well as odor and color bodies, are removed, without use of heat. After deionization, dilute glycerine is concentrated by vacuum evaporation.

▶ **Trio of New Units**—First commercial unit for purifying soap-lye crude

puts the HEAT on heat exchangers

By changing to Yarway Impulse Steam Traps, an oil refinery reports much hotter steam in their heat exchangers **—plus two other important extras:**

(1) They were able to operate the plant with 6 boilers instead of the 8 formerly required.

(2)Three men formerly required to service old-type traps can now be used for productive work.

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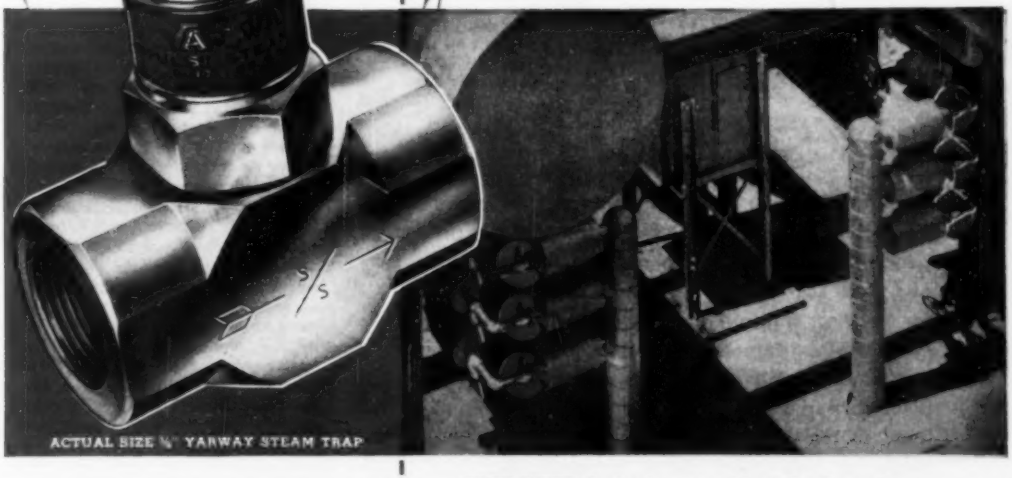

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by ion exchange has been operating less than a year. It's at the Los Angeles plant of Lever Brothers, and handles 26,600 lb. of crude per day.

Another deionizing unit at the Wyandotte, Mich., plant of Archer-Daniels-Midland Co. purifies 15,000 to 16,000 gal. of dilute glycerine sweetwater in a 24-hr. cycle. The sweetwater comes from the high-pressure hydrolysis of fats, and contains about 10 percent glycerine.

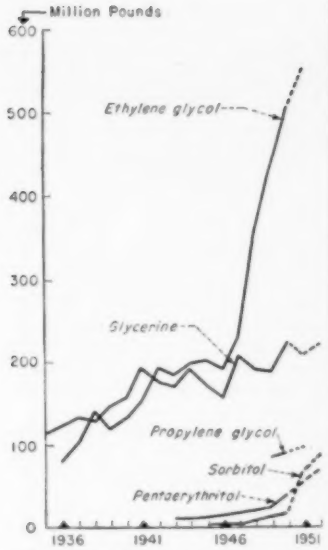
The third unit, installed last May, is at the Los Angeles plant of Vegetable Oil Products Co. It deionizes 5,000 to 9,000 gal. of Twitchell sweetwater per cycle, producing USP and even reagent grade glycerine.

► **Price Pattern**—Right after Korea, scare buying forced the price of crude glycerine above the price of refined. As a result, natural glycerine was as much as 8 c. a lb. higher than synthetic. Recently, natural glycerine was cut to 38-40 c. a lb., making it competitive with the synthetic offered on the open market.

When its synthetic glycerine plant went on stream in the fall of 1948, Shell signed long-term contracts with certain big users of glycerine, principally makers of alkyd resins, agreeing to supply them with glycerine at a price below the then market price of about 40 c. By thus insuring a market for its glycerine, Shell was able to underwrite its capital investment in the new synthetic plant. And these customers of Shell were in a nice position to ride out the post-Korean price rise in open market glycerine. Among big alkyd producers are Reichhold Chemicals, Inc., and Rohm & Haas Co. Part of Shell's current production is now offered on the open market also.

Most of Shell's output still goes into such industrial uses as resins. There's no reason why USP glycerine for human consumption couldn't be made by the synthetic process. In fact, Shell's glycerine, now being tested by the Food and Drug Administration, has come through with flying colors so far. Only possible contaminant might be residual chlorine, but apparently none has been found. However, with such good industrial outlets as alkyd resins, Shell has wisely refrained from a chemicals-in-foods fracas by not courting such markets.

► **Where It Comes From**—Output of synthetic glycerine has increased steadily, but most glycerine still comes from natural sources. From a peak of 189 million pounds in 1947, production of glycerine by soap makers has eased off to about 140 million pounds a year as the advent of synthetic detergents has slowed the rate of increase



COMPETITORS such as pentaerythritol and sorbitol now threaten glycerine.

of soap production. Offsetting this, however, is the increased output of natural glycerine by fat splitters and makers of fatty alcohols.

All told, there are 60 primary producers and refiners of natural glycerine, and Shell, the lone producer of synthetic, makes 61. Biggies in soap, of course, are Procter & Gamble, Colgate and Lever. Armour and Swift are also important soap makers. There are about 20 fat splitters. Among the major ones: Emery, Armour, Swift, General Mills, Drew, Hardesty and Archer-Daniels-Midland.

In 1951 the U. S. produced 211 million pounds of glycerine. Soap makers accounted for 130 million pounds, synthetic provided 40 million, fatty acid producers turned out 28 million pounds, and makers of fatty alcohols supplied 13 million.

Glycerine imports went up right after Korea, then fell off last year. In 1950 the U. S. imported 23,781,780 lb. of glycerine, but in 1951 imports dropped to 14,606,461 lb. They are not expected to play a big part in 1952. U. S. production seems able to meet most of the demand.

▶ **What It's Used For**—Biggest single use for glycerine is in alkyd resins. Next come its uses in tobacco as a humectant and in explosives; these two outlets are about even up. Its use as a plasticizer in cellophane comes next, followed by cosmetics and dentifrices, corks and gaskets, drugs and pharmaceuticals. Together, these uses account for about 75 per-

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cent of the market. Other uses: adhesives, paper, printing inks, printers' rolls, foods, margarine and shortenings.

▶ **Strongest Contender**—In alkyd resins, glycerine is now being challenged by pentaerythritol. This year, pentaerythritol capacity will climb to 60 million pounds a year. What's more, it sells for only 34 c. a lb., a shade under glycerine, and 80 percent goes into alkyds. Alkyd production may reach 400 million pounds this year and 500 million by 1954. Significantly, however, glycerine used in alkyds has, in the decade from 1940 to 1950, nosed downward from 2.5 lb. per pound of alkyds produced to 1.7 lb.

Sorbitol, closest akin to glycerine in character, competes in the widest range of uses—from humectants to resins. Sorbitol availability is rising to 70 million pounds a year. It's penetrating the resin market, and its derivatives are going into food emulsifiers. In anti-freeze, glycerine has been pretty well displaced by ethylene glycol, a natural for the job. Still another competitor is propylene glycol.

Compared to the competition glycerine faces from these other polyhydric alcohols, the tussle between synthetic and natural glycerine is only a schoolboy scrap. Total production of all polyhydric alcohols has grown to a billion pound a year clip. But glycerine still acounts for a big part of it, and making glycerine is currently a $100 million business. Many contenders are trying to topple glycerine from its throne, but it's still king of the polyols.

Monsanto's New Research Improves Plastics Colors

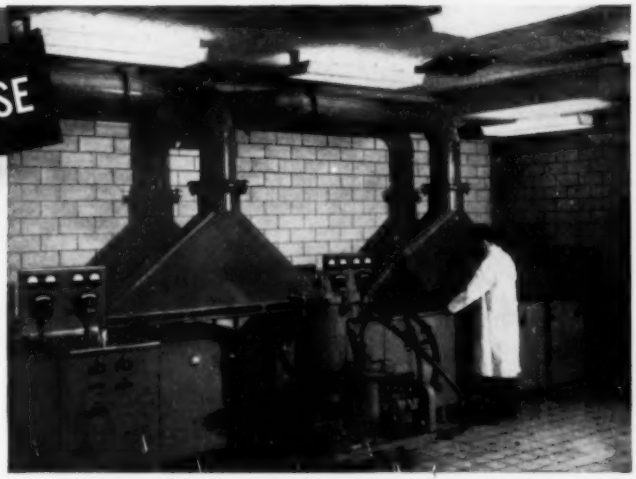
"Color is a major weapon in merchandising plastics products."

F. A. Abbiati, vice president of Monsanto's Plastics Division, also believes improved color services can help overcome some of the consumer restraint in softened markets.

Last month Monsanto announced a one-third expansion of the division's research facilities at Springfield, Mass. The company also said it would retain Faber Birren, the color expert, to advise the division in its color research program.

Projects include developing improved colors, specifications, color matching and up-grading color measurement. New facilities will include a surface coatings application laboratory, a physics lab and an enlarged library.

WESTINGHOUSE



Our illustration shows a corner of the extensive pilot plating plant at Westinghouse's East Pittsburgh laboratories, where many improved plating processes have been developed and tested.

For example, this line of 100 gallon tanks was used to perfect the company's P.R.* process of plating to secure brighter finishes by periodic reversal of the plating current.

Five Sarco Type LSI indicating electric controls actuating solenoid valves to maintain any desired constant plating temperature on 100 gallon tanks of PR process pilot line at East Pittsburgh.

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Sarco Type LSI indicating electric temperature control for all kinds of plating. Long or short temperature ranges custom made as needed. Bulletin 1026.

*For full information on this process see the article in the May 1st, 1950, issue of "Steel".

New: Sarcostat hydro-electric motor valve for use with LSI thermostats in place of solenoid valves. Powerful, direct thrust—no pilots or levers, slow opening and closing. Bulletin 1081.

337

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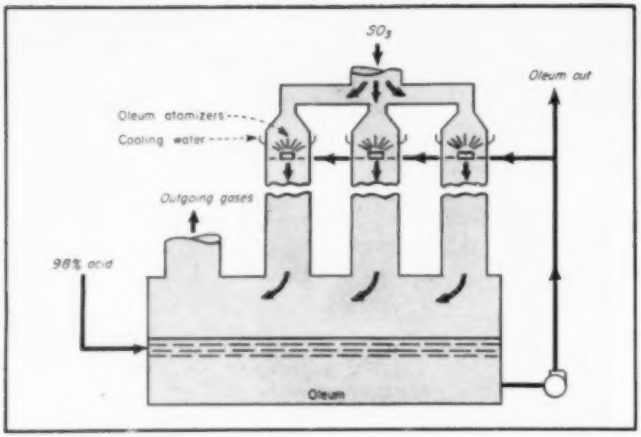


Unit efficiently utilizes almost its entire surface for cooling.

Simpler Way to Make Oleum

Absorber-cooler equipment beats old-style methods. It's smaller, simpler, flexible, cheap, uses only a minimum of circulating liquid.

The trick in making contact-process oleum is in cooling both the sulphur trioxide and the unenriched oleum. Generally this takes a two-stage operation and extensive equipment. Now one simple unit can deal with all necessary cooling as well as the absorption of SO_3.

Compagnie de Saint-Gobain developed the unit. And they've recently installed it in their plants at Chaune and Rouen, France.

▶ **All There Is to It**—The unit is made up of a number of tubes, total diameter 250 to 500 mm., mounted vertically in parallel on a tank fitted with a circulating pump. Inside the top of each tube sits an oleum vaporizer.

Open hearth low-carbon steel is the construction material used for all equipment but the vaporizers. They can be of 18-8 stainless.

Sulphur trioxide comes from the converters into the top of the tubes. There they intimately contact the oleum which has been pumped up through the vaporizers from the half-filled tank. Gases then pass on through the tank and out a series of tubes with perforated tops. Oleum is graded in the tank by means of 98 percent sulphuric acid.

Almost the entire surface of the apparatus is used for cooling. Water running down the outside of each tube absorbs the heat of the oleum circulating inside. Heat transfer coefficients may even exceed 500 cal. per sq. m. per deg. C., as between the oleum and water. And the tank itself can be sprinkled.

▶ **Striking Contrast**—Simplicity of the new equipment contrasts strikingly with conventional methods.

In the past, Saint-Gobain had often carried out the operation in two phases. First the sulphur trioxide passed through cooling equipment where it was cooled with natural or forced circulation air. Next it entered the absorption apparatus which included in its circuit a water cooler for oleum.

Cooling of gases by air calls for large exchange surfaces due to the low coefficient of heat transfer. Cooling of oleum is easier since the exchange coefficient is approximately ten times greater. But absorption apparatus, consisting of one column and its accessories is voluminous.

For an installation producing 100 tons of SO_3 a day, surface of the new absorber-cooler doesn't exceed 90 sq. yd.

In contrast, the conventional installation consisted of a tower requiring about 120 sq. yd. of steel plate and cooling set-up for oleum with a surface of 140 sq. yd. This total surface of 260 sq. yd. is almost three times that of the new Saint-Gobain absorber-cooler.

Predict Production Trends Of Some Major Chemicals

With the exception of formaldehyde, many of the top chemicals will continue their rapid growth in production and sales. At the recent meeting of the Chemical Market Research Association at New York's Hotel Roosevelt, industry spokesman made their forecasts:

• Today antibiotic drugs are used on about 25 percent of all medical patients. Between 40 and 50 percent, Pfizer's J. L. Packard reasons, could be aided by the drugs. Exports also offer a big future market, he figures.

• Among the coal-tar chemicals, benzene and naphthalene should enjoy the greatest growth, according to G. D. Bieber of Eastern Gas & Fuel Associates. Benzene sales were expected to rise from 260 million gallons in 1951 to 430 million gallons in 1956.

• Synthetic detergent production should total 2.5 million pounds and possibly push 3 million pounds by 1960, according to C. P. Neidig of White, Weld & Co. They now account for 50 percent of sales of packaged detergents. In a few years, they will probably account for 75 to 80 percent, he said.

• Production of formaldehyde has doubled since 1945. But the growth curve is expected to level off, unless some big developments come along, according to A. A. Williams of Celanese. Supplies are coming into balance with demand, and there may be some excess production for a time.

Freeport Plans To Go Ahead On New Sulphur Projects

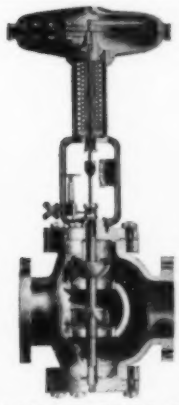
At Nash dome, about 35 miles southwest of Houston, Freeport Sulphur Co. will undertake their third mining development. Deposits here are considered marginal under present conditions. But company officials believe the market will change.

"We concluded early in 1952 that, in view of the increased demand for sulphur, we should proceed with the construction of a sulphur mining plant," their 39th annual report bluntly states.

Looking to the future, the company obtained rights to 7,800 acres of land containing sulphur-bearing ores in Carroll County, Va. Developments on new sulphur mines at Bay Ste. Elaine and Garden Island Bay in the Louisiana marshes have started.

Last month, Freeport announced the cost of the various projects: $20 million.

76 BS&B CLIMAX CONTROLS CENTERS



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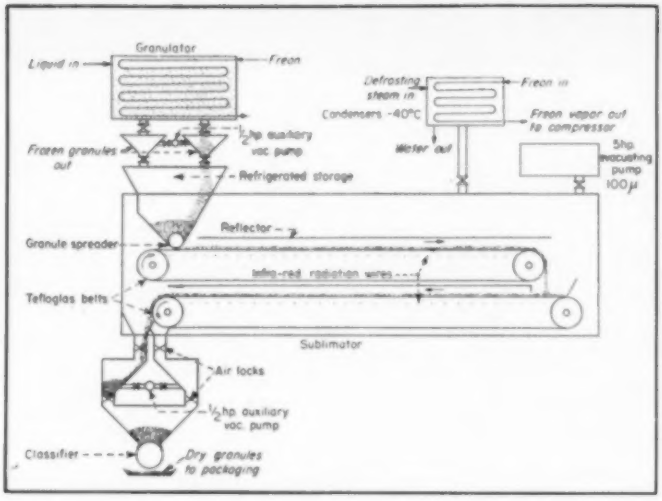


Freeze Drying Growing Up

Freeze-drying, a healthy war baby, is growing up fast. Latest development is this Dry-Freeze unit. It sublimes frozen pellets of liquid product with radiant energy.

During the last war when the call went out for huge quantities of blood plasma and penicillin, process engineers learned about low temperature drying in a hurry. Since then, renewed demands have consistently come up. They have had no time to stop learning.

When the switch was made from batch to continuous processing, several difficulties cropped up. One problem, getting the liquid into the evaporator, caused some trouble. Spraying was one answer, but the technique had its drawbacks—some flash evaporation of volatile portion of product, and uneven layers deposited on the sublimer belt.

To skirt the difficulty, development engineers from Dry-Freeze Corp. and Proctor & Schwartz, Inc., who teamed for the project, tried freezing the liquid first. To do this, they worked up a granulating device that freezes the liquid in the form of small (usual size—¼ in.) pellets. Result: no evaporation loss and an even layer deposited on the drying belt.

Previously, they worked out an infra-red heating system. When heat transfer is the controlling mechanism, freeze-drying with radiant energy is more rapid than with conduction heating, Proctor engineers claim.* In one instance, drying capacity for an organic dye was increased by 74 percent because of penetrating radiation.

Proctor, who will make the developed freeze-drying unit, will soon send the commercial undertaking on its way. It is now setting up equipment in a food products plant. Other units, intended for processing organic chemicals, pharmaceuticals and gums, are in the planning stage.

▶**Advantages**—In sublimation or freeze-drying processes, the end product is dry, porous and chemically pure. Porosity caused by the sublimation increases rates of solubility, reaction and dispersion of the dried product. Treated dyes disperse readily and have less tendency to agglomerate. Pharmaceuticals retain their potency and food products their natural flavor.

Since many batch dryers are used in the process industries, the freeze-drying process may make quick inroads. Continuous operation cost less in capital and labor, and is seven times faster. Generally batch processing is limited to materials priced by the gram.

▶**How it Works**—Freon refrigerant coils in the granulator chill the liquid feed. Frozen pellets drop alternately into two hoppers. When the hopper fills, the top airlock closes, the bottom opens and a 0.5 hp. pump evacuates the hopper. The top airlock of the storage hopper opens and the pellets pour in.

From the storage hopper, the pellets drop onto a Tefloglas belt. A spreader levels a layer one pellet deep. Although only two belts are shown above, a series of countercurrent belts shuttle pellets back and forth within the 5 ft. diameter by 60-90 ft. long evacuated sublimator.

Although the pellets pass within a few inches of 1,000-1,200 deg. C. infra-red radiation wires, the pellets maintain a constant temperature of −20 deg. C.

Water in the pellets absorbs radiation in depth, not merely on the interface. The material processed determines the type, size and spacing of the infra-red wires that have a radiation range from 2-9 microns. High intensity drying calls for Nichrome wire of high emissivity. A special alloy wire handles low emissivity requirements. Each wire pulls about 4 amp. from a 110-v. circuit. Wires are connected in series up to load capacity of the circuit, and these series circuits are connected in parallel.

Two 5-hp. pumps evacuate the sublimer to 100 microns pressure. Both pull the original vacuum, but one pump can hold it.

Water vapor sublimed from the pellets is pulled into a 3x6-ft. condenser. Condenser coils, held at −40 deg. C., are defrosted with steam periodically by blanking off the condenser from the system. Only one condenser is shown, but four or five are actually used. Thus the loss of condensing capacity amounts to only 20-25 percent when one condenser is defrosted at a time.

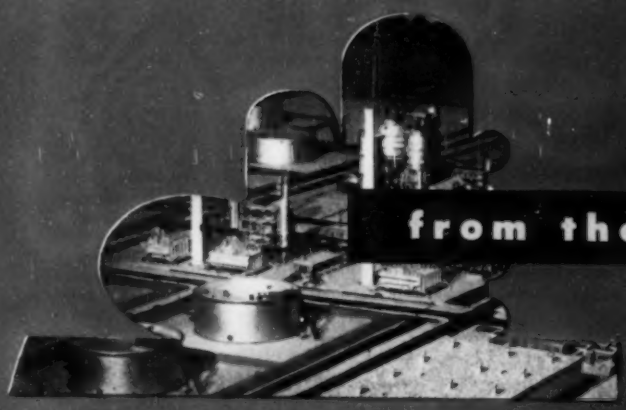
Dehydrated material falls from the final belt through an airlock into an evacuated hopper. When the hopper fills, the top airlock closes, the bottom one opens and the material feeds to the classifier.

From the classifier, dehydrated material feeds to a belt leading to packaging units. If the product is sold, users of the freeze-drying unit will have to obtain licenses under the issued patents (#2,445,120, 1948 and Re. #20,969, 1939) and pending application.

▶**Key Parts**—The granulator and the Tefloglas belt are the key items in the freeze-drying unit. The granulator of course is the chief gimmick, and at the moment, Dry-Freeze is mum about its operation and construction.

* Zamsow, W. H., and Marshall, Jr., W. R., *Chem. Eng. Prog.*, **48**, 21, Jan. 1952.

new products



from the refinery

Ethylene . . . Aromatics . . . Hydrogen . . . Sulfur . . . Ammonia . . . Alcohols

These products are now being made in petroleum refineries.

Foster Wheeler's integrated engineering and construction organization has served both the petroleum and chemical industries for over 30 years in the design and construction of process units and complete refineries and chemical plants.

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FRED BOND puts his new theory of comminution through the test of experiment.

New Theory Explains Grinding

Bond's theory explains, for the first time, how much work it takes for crushing and grinding. You can use it to figure out the efficiency of your own operations.

Have you ever wanted to compare the efficiency of your new hammer mill with your old jaw crusher?

You can do it now with the new theory developed by Fred C. Bond, who is the engineer in charge of technical research at the processing machinery department of Allis-Chalmers Mfg. Co., Milwaukee.

Bond's theory—he calls it the Third Theory of Comminution—states that the total work required for crushing and grinding varies inversely as the square root of the product size.*

When you know the work input, feed size and product size of one reduction, you can use the new theory to calculate the work required for any size reduction. You can compare directly the relative efficiencies of different operations and circuits with different feed and product sizes.

After laboratory tests, you can even compare the relative efficiencies of plants reducing different materials.

► **Topples Old Theories**—Bond's completely new theory of comminution pretty well shatters the older Rittinger and Kick theories. Neither of these has ever been applied in a practical way, Bond says, to ordinary crushing and grinding over a large size range.

Rittinger's theory postulates that the useful work done in crushing and grinding is directly proportional to the new surface area produced and inversely proportional to the product diameter. It was later amplified by Gaudin: "The efficiency of a comminution operation is the ratio of the surface energy produced to the kinetic energy expended."

By this theory, even the best values for surface energy indicate that 99 percent of the work input is wasted. Bond also points out that Rittinger's theory ignores the distance factor (particle deformation before breakage) although work is the product of force multiplied by distance.

Kick's theory is based primarily on the stress-strain diagram of cubes under compression. It states that the work required is proportional to the reduction in volume of the particles.

But crushing and grinding do not follow the laws of the theoretical breakage of cubes, Bond contends. He emphasizes that neither the Rittinger theory (concerned only with surface) nor the Kick theory (concerned only with volume) can be completely correct.

► **The Third Theory**—The new theory states that the total work useful in breakage is (1) inversely proportional to the square root of the diameter of the product particles, (2) directly proportional to the length of the crack tips formed, and (3) directly proportional to the square root of the surface area formed.

Bond points out that the immediate objective of crushing and grinding is to form cracks, which are then spread through the deformed particles by the flow of resident energy to the crack tips. The essential work input must be able to deform the particles beyond their critical strain and to form crack tips. Thus the total useful work input is directly proportional to the effective length of the tips formed.

Work input required to reduce from an infinite feed size (Wt) is

$$Wt = W\left(\frac{\sqrt{F}}{\sqrt{F}-\sqrt{P}}\right)$$

when F is the diameter which 80 percent of the feed passes, P is the diameter which 80 percent of the product passes, and W is the work input in kwh. per ton.

If F and P are in microns and Wi is the work index or total kwh. per ton required to reduce from infinite size to 80 percent passing 100 microns (or about 65 percent passing 200 mesh) then the Bond equation becomes

$$Wi = W\left(\frac{\sqrt{F}}{\sqrt{F}-\sqrt{P}}\right)\sqrt{\frac{P}{100}}$$

If F and P are in inches, the number 100 should be replaced by 0.003937. If the feed has been scalped, the equivalent size of a normal feed should be used.

Work index (Wi) can be calculated from laboratory tests or from any plant operation where W, F and P are known. When the work index is known, the work input required for any size reduction can be calculated.

► **Backed by Research**—Bond, a metallurgical engineer from the Colorado School of Mines who has been with Allis-Chalmers since 1930, has done extensive experimental work in comminution at Allis-Chalmers' processing machinery laboratories.

He has, for instance, compared the work index—key figure in any crushing and grinding problem — from a large number of laboratory tests on impact crushing, ball mill grinding and rod mill grinding. He has also calculated the index for many large

* Bond presented his new theory in detail at the annual meeting of the American Institute of Mining & Metallurgical Engineers in New York on February 21.

plant installations from published data.

Significantly, Bond finds that the work index values are consistent and reasonable over all size ranges for a homogeneous material reduced at the same relative mechanical efficiency.

He emphasizes, however, that care must be used in applying the index to specific problems. Variables such as machine speeds and sizes, oversize in feed and pulp dilution may call for correction factors.

It's certain, though, that engineers throughout the chemical processing and process equipment industries will welcome Bond's theory and its concept of work index.

For now chemical engineers can shoot for more efficient operations through closer predictions and more accurate comparisons of all crushing and grinding operations.

New Chloromycetin Plant Will Be World's Largest

Chloromycetin is the only antibiotic made synthetically. Last month, Parke, Davis & Co., the only producers of chloromycetin, officially opened their Holland, Mich., plant. It will be the world's largest source of the three-year-old antibiotic.

The plant, consisting of a cluster of 19 buildings on 28 acres on the north side of Lake Macatawa, was started two years ago. First steps in the complicated processing are underway. Thousands of gallons of cooling water and more than 18,000 lb. of ice are used during one hour of operation.

More than four miles of aluminum tubing connect a buried 124,000 gal. "tank farm," where special chemical solvents are stored, to measuring gages in the control room. Chemical wastes go into a 1,600-ft. well, below any source of surface water.

Sunray Oil Now Building 816 Million Refinery

Viola is six miles northwest of Corpus Christi, Tex. Last month, here on a 140 acre tract, recently purchased from Southern Minerals Corp., Sunray Oil Corp. broke ground for a $16 million refinery.

When completed, the refinery's cat crackers will be able to handle 25,000 bbl. of crude oil daily. The refinery will turn out aviation gasoline—produced with a minimum of fuel oils, products for the petrochemical industry and high octane motor gasoline.

Sunray, which received a rapid tax write-off last fall for the construction of the plant, has large reserves and a pipeline system in South Texas.

for men concerned with COLOR

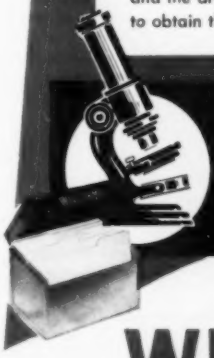
Pigment Costs Reduced 60% by Maker of Leather Finishes

A pure Indian Red was causing trouble for a company making leather finishes.

The company came to us stating that it was obtaining a wide range of color effects.

Our analysis of this company's formula revealed that the pigment was uniform . . . but it was too highly concentrated in relation to the amount of vehicle being used. As a result, there was insufficient vehicle in the final film to completely coat the pigment and fill the voids between the pigment particles. This gave an optical effect of darkening.

To cure this situation, we developed a new formula which called for a 60% reduction in the amount of Indian Red. Enough pigment still remained to give complete hiding . . . and the drastic reduction enabled the company to obtain the uniformity of color it was seeking.



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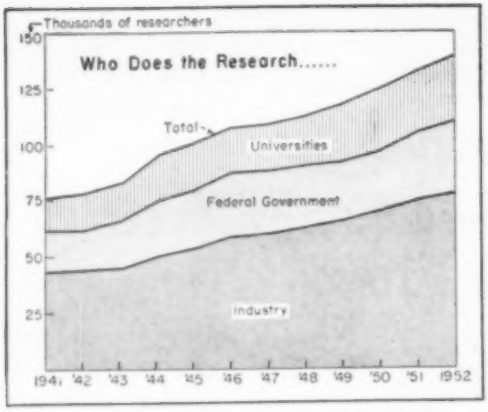
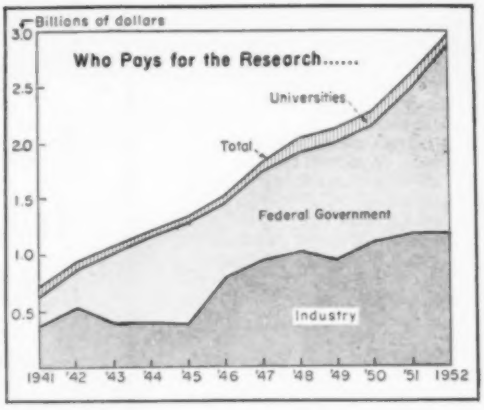




Uncle Sam Now Controls Lion's Share of Research

New data show that the nation's bill for research and development this year will hit close to $3 billion. Uncle Sam is paying for more than half of it.

This year, more than $20 for each person in the U. S. will be spent on research and development work. The total of almost $3 billion now approaches 1 percent of the total national income.

But research costs more today than ever before. While the total dollars spent has tripled in the past decade, the number of persons in research and development work hasn't quite doubled. This reflects the shrinking value of the dollar.

These are some of the highlights of the new data brought out in a recent study of trends in research and development. The study, made by the Department of Defense's Research & Development Board, is here summarized for *Chemical Engineering* by Kenneth S. Colmen and Robert Zalkin of the board's resources division.

▶ **Engineers In Research**—Close to 20-25 percent of the nation's engineers and scientists are now in research and development work, Colmen and Zalkin report.

Right now, for example, this amounts to about 40 percent of the nation's 185,000 scientists and 15 percent of its 415,000 engineers. There is a trend, however, for engineers to go into research and development.*

Some 60 percent of all research engineers and scientists work for industrial organizations, about 20 percent for universities and another 20 percent for the federal government, the authors point out.

While industry has added to its research staffs steadily for the past two decades, the big expansions in government staffs have taken place during wartime. University researchers increase primarily in times of peace.

World War II, they state, was the first war in history to be affected decisively by weapons unknown at the outbreak of hostilities—a fact that has lifted research and development from a rather obscure activity to a vigorous and expanding industry. The present crisis has again raised it to a new peak.

▶ **Uncle Sam's Big Part**—One of the significant trends brought out by the Colmen-Zalkin figures is the dominant position the federal government now occupies in research activities (see chart).

While industry and the universities employ more than 75 percent of the nation's technical researchers, the federal government is actually footing about 55 percent of this year's research costs. At the peak of World War II, almost 70 percent of the country's research funds were provided by federal agencies.

This year research by private industry will tot up to about $1.8 billion. But industry itself will pay for only $1.2 billion. This means that one-third of industry's research is being performed on contract for the federal government.

Actually, only about 50 percent of the research expenditures by federal agencies represents work done in government laboratories. The remainder is contracted to industry and the universities.

Of the total cost of all research and development this year, the Federal government is paying for about 55 percent, industry about 40 percent and the universities close to 5 percent.

▶ **For Defense and AEC**—Most of the contract work by industrial organizations is done for the Department of Defense and the Atomic Energy Commission. The bulk of it is in the fields of aircraft, electronics and chemistry.

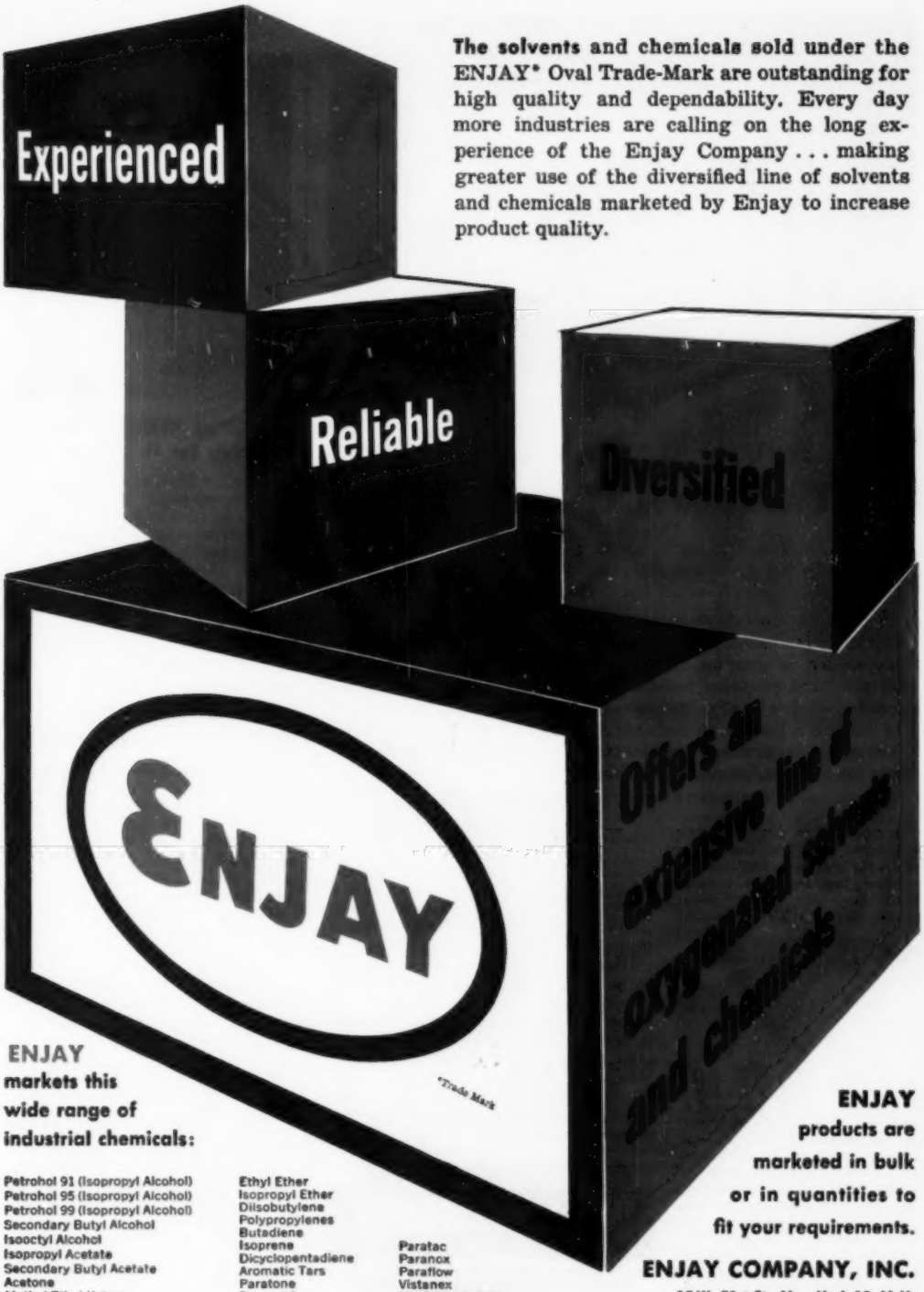
And because of the size of the defense research program, these three fields will feel the shortage of engineers and scientists most severely.

Colleges and universities do most of the nation's basic research. Before World War II this was largely supported by the universities themselves.

Now, however, the federal government supports a large portion of the university program. In 1952 the Department of Defense alone will spend more than $60 million for basic research. Almost all of it will be done at colleges and universities.

Since Defense now supports more than 40 percent of the nation's research and development effort, it is important to note a policy statement of the Research & Development Board. This states that at least 6 percent of the average of Defense's budgets for the previous five years must be spent annually for basic research.

* Hereafter the term "research" will be used to denote "research and development." The estimates of the magnitude of research expenditures are higher than those currently available. But Colmen and Zalkin believe they are conservative because of the difficulty of uncovering research programs that are an integral part of production and other activities.



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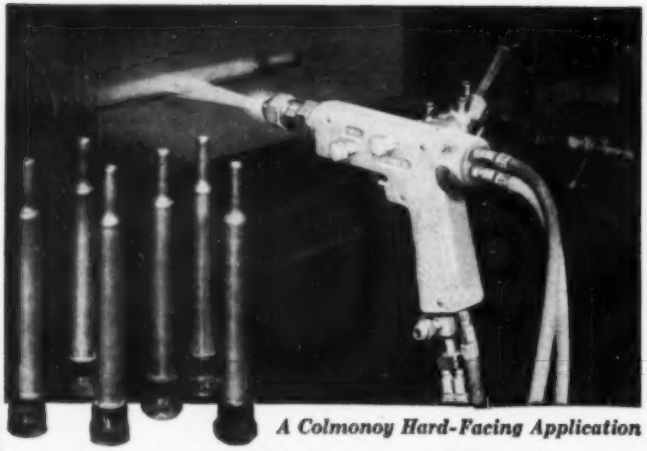

A Colmonoy Hard-Facing Application

Thermocouple Wells Hard Faced with SPRAYWELDER last 7-10 times longer

The fast destruction of thermocouple protection tubes may now be prevented by the use of a remarkable hard-facing alloy and a metal-spray welding method called the COLMONOY SPRAYWELD PROCESS.

The photograph shows a thermocouple protection tube, made of inexpensive mild steel, mounted on a lathe. A powder spray gun, the Spraywelder, is spraying COLMONOY No. 6, an extremely erosion, oxidation, and corrosion resistant nickel alloy. After spraying, the deposited alloy is fused to the base metal with an oxy-acetylene torch. The result is a smooth, welded overlay, as shown on the tubes above. When placed in service, tubes like these have given from seven to ten times the life of tubes previously used.

The COLMONOY SPRAYWELDER has many profitable uses in the process industries. While the method illustrated above lends itself especially to cylindrical parts, such as pump shafts,

sleeves, plungers, pistons, etc., *any* part, regardless of shape and contour, may be sprayed. Because the overlay may be held to within .010" of the desired size, less alloy is used and far less grinding is required than with other hard-facing methods. The Spraywelder may also be used as a standard metallizing gun, will spray copper, aluminum, stainless steel, etc.

COLMONOY No. 6 has many other applications. In the form of gas welding rods it is used for hard-facing valves, valve seats, pump seal and wear rings. COLMONOY No. 6 may also be cast for small precision parts.

COLMONOY is a complete line of hard-facing alloys, made to resist impact, abrasion, and corrosion, singly or in combination. To accomodate application methods, they come in various forms: powder, rods, electrodes, paste, and metallizing wire.

Write and ask for more information: about COLMONOY alloys, about equipping yourself with a Spraywelder, or for the name of your nearest Sprayweld shop.

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Bureau of Standards Has Synthesis for Hot Sugar

Bureau of Standards' chemist uses ion-exchange resins to de-ionize an aqueous solution of radioactive sugar. Previously a sugar acid lactone was reduced to sugar by the action of sodium amalgam in acid solution. NBS recently worked out methods for synthesis of sugars bearing radioactive carbon atoms. Tagged sugars will be valuable tracers in studies of carbohydrate metabolism.

Cat Water Conditioner Works, But Who Knows How

Conventional methods for softening water require periodic addition of softeners or recharging of ion exchange beds. A method developed by Evis Manufacturing Co., recently formed San Francisco firm, conditions water through catalytic contact, requires no chemicals or maintenance.

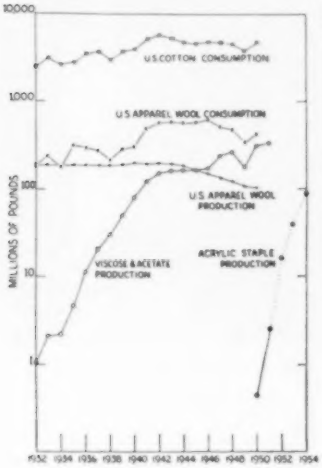
The Evis process does not eliminate chemical hardness as such, but affects the physical characteristics of water so that dirt, soap curd and boiler scale particles remain well dispersed or sequestered. Thirty-eight-year old inventor Arthur N. Wells admits he cannot explain why or even how his conditioner works.

The unit is cast as an enlarged pipeline fitting with one or more posts placed in the path of flow. The entire unit operates as a catalyst, with the center posts as the major contact area. Additives are used to impart catalytic properties to the metal. But what is catalyzed, or how, no one has yet been able to explain.

Evis units are 100 percent efficient in water containing less than eight grains per gallon. Suds will form and hold with small amounts of soap—enough to perform a complete wash

in distilled water. But since pipelines and hot water heaters are first cleaned and de-scaled, it sometimes takes up to 60 days to reach maximum softness.

Units have been installed in a cement kiln, pulping plant, laundries and homes. Thus far the most spectacular results have been in marine evaporators. Eight West Coast shipping companies, including Pacific Far East and American lines, report no scale formation when the Evis is used. And old scale is either removed entirely or so softened that it can be blown off with a low pressure hose.



Acrylic Output Climbs Fast

In two years the nation's total projected capacity for all acrylic fibers will be over 90 million pounds a year. Union Carbide, the latest chemical company to disclose big acrylic plans, has applied for a certificate of necessity for a $30 million dynel staple fiber plant that will turn out 20 million pounds of dynel a year. Units for the production of raw materials to feed the plant will be built at Institute, W. Va., and South Charleston, W. Va.

Largest Newsprint Mill In South Will Expand

First newsprint mill built in the South, the Herty Mill in Lufkin, Tex., is still the South's largest mill. About half the daily newspapers in Texas are its customers.

Recently Southland Paper Mills at Lufkin received approval from the Defense Production Administration for a $15 million expansion program. The plant was one of three in the U. S. receiving certificates of necessity

to the Chemical Process Industries

Technical complexities within the Chemical Process Industries can often make a heat transfer problem "that tough nut to crack". Good reason for Western Supply Company engineers to continue offering the "Helping Hand of Service" wherever and whenever heat transfer engineering is involved. Sizing, rating, designing, fabricating shell and tube exchangers; floating head exchangers; atmospheric sections; telescopic exchangers and reboilers. Check your operational records . . . if heat transfer is a problem consult with Western . . . they'll be glad to help.

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Premium purity means that Darco G-60 is free of extractable contaminants . . . is low in iron and other metals that can cause so much trouble in processing fine chemicals and pharmaceuticals.

There's *more* to the Darco G-60 story! This outstanding carbon also gives you all the advantages of high adsorptive capacity . . . low retention loss . . . maximum filterability. Write for the complete story and a sample of this outstanding carbon.

IMAGINUITY AT WORK

Trying to eliminate a phenol that won't adsorb directly? Possibly it will resinify with formaldehyde, thus forming a less soluble and more easily adsorbed compound. Then treat with Darco G-60.

DARCO G-60

Highest purity... by the gram or carload

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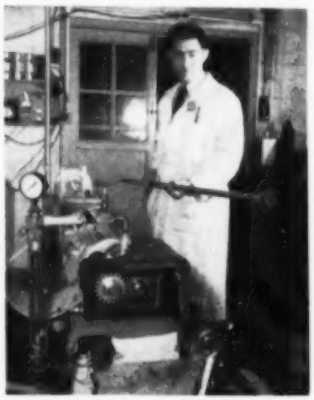
for new construction. The Southland expansion was approved in its entirety for a 45 percent writeoff.

Expansion at the East Texas mill should provide 60,000 tons of newsprint annually. But before construction can begin, the government will have to allot scarce materials for Southland. However, since newsprint is high on the federal priority list, allocations should come through.



Radioactive Brush-Off

Shell engineer F. C. Younger is about to place a radioactive gear on a wear test machine. It will mesh with an ordinary gear already set up. At Emeryville, Shell Development Co. is using these radioactive gears, sent from Oak Ridge, to test various types of lubricants. While the gears rotate under simulated industrial or automotive conditions, circulating lubricant rinses away all microscopic particles worn from the gears. A Geiger counter along the oil lines discloses the trace of radioactive particles in the oil stream. The intensity of the radioactivity in the oil indicates the amount of wear on the gears.

Process Treats Wood In Vacuum Seal Unit

Wood treated with pentachlorophenol has a high resistance to fungi and wood-destroying insects, as well as a high degree of dimensional stability.

A new process, which uses a vacuum sealer unit, assures better penetration and distribution of the treating solution in the wood.

Last month, Wood-Treating Chemicals Co. and Carr, Adams and Collier Co. jointly announced the development of the unit. It treats sash, frames and other millwork with penta-

chlorophenol preservative and water repellent. The companies say the process is faster, cleaner and more efficient than presently used open-tank immersion methods.

The vacuum sealer unit consists of a two-section vertical treating vessel, millwork cage and the auxiliary units, and controls for the automatic operation of the system. The upper portion of the treating vessel is automatically elevated for charging wood into the vessel.

In a normal sequence, the upper portion of the treating vessed is raised to permit charging and lowered prior to drawing a vacuum. The cage is then submerged into a treating solution reservoir in the lower portion of the vessel. Excess solution is removed by a final vacuum applied after this cage is raised.

News Briefs

Corrosion: Army Corps of Engineers are testing rubberized pavement. Jet fuel spillage has a disintegrating effect on certain types of runway pavement. Air Force has requested tests to determine if rubberized pavement will be more resistant.

Plastics: Nylon is finding many new applications. Business machine industry uses nylon for more than 100 parts of machines now in production. An electric shaver uses it as a connecting rod that operates at 16,000 cycles a minute.

Metals: National Bureau of Standards has developed an accurate spectrophotometric method for the determination of bismuth in lead-base and tin-base alloys. The method appears to be ideally suited for testing solders, type metals and other lead-tin alloys in industrial laboratories.

Taconite: Minneapolis-Honeywell has developed an improved technique for processing taconite that gives finer temperature control and a more exact fuel-air ratio.

Aluminum: Aluminum Co. of Canada is experimenting on aluminum towers for a powerline from its powerhouse at Kemano to the smelter site at Kitimat, B. C. If they work out, the 100 ft. towers would save considerably on steel.

Pulp: H. R. MacMillan Export Co., Ltd., which recently merged with Bloedel, Stewart & Welch to form MacMillan & Bloedel, reported a net earnings last year of $15,611,-138, more than double the 1950 figure. —*End*

WESTON TAG Thermometers

in all forms—ranges—stem lengths—connections

Whether your requirement calls for certified laboratory thermometers . . . or rugged all-metal industrial types . . . or thermometers for remote reading . . . you'll find *exactly* what you require in the Weston-TAG line—*the most comprehensive line of quality thermometers ever offered by ONE manufacturer.* Literature on request. WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey.

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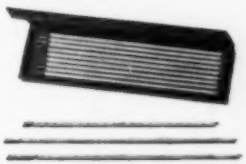
—have readable, dial-type scales and corrosion-resisting stainless steel stems—stem lengths from 2" to 24"—ranges from low as −100°F. to high as 1000°F.—accuracy ½ of 1% of thermometer range.



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—certified sets of ASTM Testing thermometers with overlapping ranges in protective case. Ranges from −36°F. to high as 760°F. Also precision and standard etched stem thermometers for general testing.

Industrial

ALL-METAL

—provide unmatched readability and durability—accuracy within 1% of thermometer range. Available in all types, ranges and stem lengths (2½" to 72") for all requirements.

GLASS (Metal Case)

—available in all forms, all ranges, stem lengths and connections. Accuracy within one scale division. Also submarine types, metal and cupcase thermometers.

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—resistor bulb sensing element permits mounting indicator any distance away from point of measurement. *Multiple* remote readings also possible by use of selector switch and several bulbs.

PRESSURE ACTUATED

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WESTON Temperature Instruments

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9433

Readers' Views & Comments

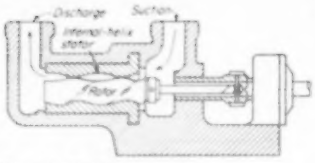


Fig. 14—Single-screw pump.

Pump Corrections

Sir:

I would like to call attention to several errors in the printing of my report on "Pumps" in your March issue (pp. 155-169).

On p. 159 the illustration used for Fig. 14 as a single-screw pump is actually not a single-screw pump. Fig. 14 should show a pump with a helical stator—the Moyno type.

On p. 169, item 8 near the top of the first column should refer to "item 2 above," not "item 3."

Also on p. 169, near the top of the third column, reference to Fig. 56 should be omitted. No illustration of "sanitary" construction is included; Fig. 56 is another type of pump.

R. E. Dolman

Wilmington, Del.

▶ *We regret that lack of space limited us to only 56 of the 93 illustrations which Author Dolman submitted with his manuscript. Our vice-president in charge of editing the illustrations got two of them confused. We are glad to publish the right one above.*—Ed.

Sulphur from Gas

Sir:

In your sulphur report, January 1952, page 173, there is a misstatement I should like to have you correct. The article states that Jefferson Lake Sulphur Co.'s process for recovering sulphur from sour gases has not yet been offered commercially.

Contrary to this statement, the Chemical Construction Corp. has been cooperating with Jefferson Lake Sulphur Co. and is offering the process in commercial size units.

E. S. Roberts

Vice President and Chief Engineer
Chemical Construction Corp.
New York 22, N. Y.

▶ *Jefferson Lake Sulphur's process is one of the newer and less orthodox methods for recovering sulphur from sour gases. We've followed its development with interest, hope soon to report the progress being made.*—Ed.

California's Lure

Sir:

When you describe critical engineering manpower situations, you should make geographical qualifications . . . the Pacific Coast does not suffer this shortage.

Not long ago a local organization advertised for several varieties of technical help and was deluged with applications for months afterwards. . . .

Maybe firms hard pressed for help should consider establishing technical setups here that could be separated or divorced from their other operations . . . they should then be able to get all the help they require. I know engineers that have done some peculiar things just to live on the Pacific Coast.

What I am trying to do is to convey to you the appeal and attractiveness of this area to engineers and chemists used to seeing the dismal industrial areas of the East (there are exceptions, of course). Once enjoyed it's not easily forsaken. . . . This attraction could be well used in recruiting technical help.

Howard S. Burnside

Menlo Park, Calif.

▶ *Reader Burnside is 100 percent right on each point; one well known chemical engineer we know swears he'll run an elevator in San Francisco's Russ Building rather than return to his firm's headquarters in the East.*

In support of Reader Burnsides' suggestion is the well-known fact that chemical research organizations in California have little or no trouble in getting top-notch technical personnel.—Ed.

Agglomeration

Sir:

I should like to thank you very much indeed for your prompt reply and for the information on pelletizing processes.

Your October report on Agglomeration has been found very interesting by my team . . . .

F. B. Karthauser

Engineer
National Coal Board
London, England

▶ *We've had a heavy request for reprints for our October report on Agglomeration, confirming our feeling that the gap in the literature on this important unit operation needed to be filled.*

Within a few months we'll be able to offer you a feature report on Size Reduction.—Ed.

Conoco's Expansions

Sir:

Your February issue (p. 178) carried certain information on Continental Oil Co. which is not accurate.

The expansion program now underway at our Lake Charles, La., refinery involves an expenditure of some $24,000,000 instead of $7,500,000 as listed. You also list Continental projects at Baton Rouge in the amount of $23,000,000 and at Houston in the amount of $10,000,000. We do not have refineries at either of these points . . . .

Emerson G. Smith

Supervisor of Publications
Continental Oil Co.
Houston, Texas.

▶ *Thanks, Reader Smith, for setting us straight on the magnitude and location of Conoco's expansion.*—Ed.

Not Paperboard

Sir:

It isn't often we are able to catch your magazine slipping, as in my opinion you are doing the outstanding job among American technical magazines . . . .

In the February issue (p. 240) you show a flowsheet for a "paperboard plant." Now while Fibreboard Products does make a lot of paperboard, as the terms are understood in the industry, what you show is a plant for a solid kraft container sheet.

Paperboard, in the technical sense, is made of reworked paper to the extent of 80-100 percent of its composition . . . . There is a minor exception to this in the solid pulp sheets used for butter and ice cream cartons, but their volume is relatively insignificant.

H. D. Fisher

New Haven 15, Conn.

▶ *Alert Reader Fisher caught us tripping in one of our captions. While the flowsheet started out to emphasize only the paperboard operations, it ended up with much greater emphasis on the kraft paper and carton stock. The text is straightforward and properly emphasizes the kraft operations.*—Ed.

Illinois' Eisenschiml

Sir:

The first time you ask me two questions, I can't answer either of them.

I do not know the Old Timer you're

looking for, and I do not recall when I first subscribed to *Chem. & Met.* All I do know is that the records of the year when I started have been discarded, which proves that the beginning dates a long way back.

I do not think my long subscription record entitles me to a special honor, any more than old age alone, or living in a community for any number of years bestows distinction on a man. He reaches old age because he hasn't died, and he keeps living in one community because he is happy there.

Likewise, a man reads a magazine year after year because it is a good magazine, and has become a pleasure and a necessity for him. Whatever honor there is in this should go to the paper, not to the subscriber. This is the way I feel about *Chem. & Met.* and its successors. . . .

OTTO EISENSCHIML
Chicago 23, Ill.

► *Reader Eisenschiml comes back with a refreshing bit of the salty philosophy he's noted for.*—ED.

California—I

Sir:

We were under the impression that our subscription existed before January 1912, but we have no records to verify this.

Our firm was established in 1866 (85 years) and has been in business continuously since that time. We have very much enjoyed and have greatly benefited by having your publication in our library.

HERBERT D. IMRIE
President
Abbot A. Hanks, Inc.
San Francisco, Calif.

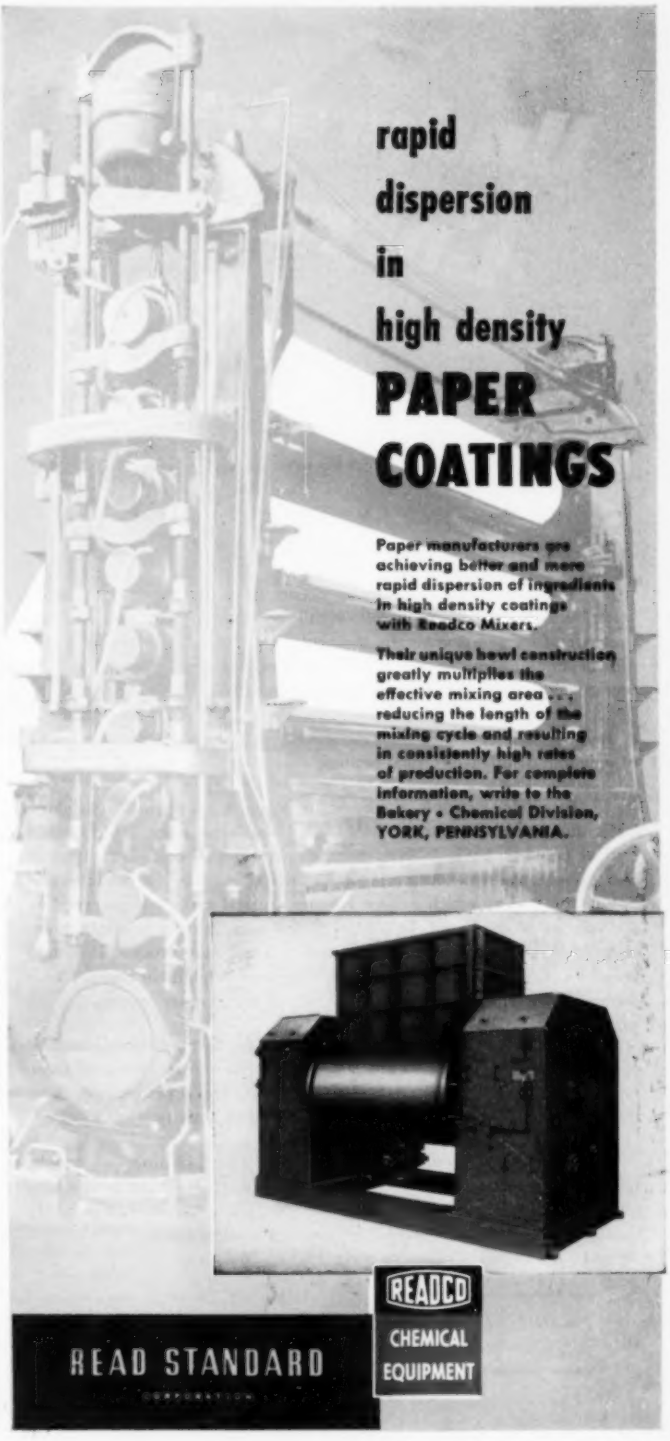
California—II

Sir:

. . . We find (upon checking our basement storage and digging out under years of accumulated dust) that . . . evidently the first year we subscribed to *Chemical Engineering* was in 1909.

FRED W. TWINING
The Twining Laboratories
Fresno, Calif.

► *Looks like the Twining Laboratories beats by about three years another well-known California organization, Abbot A. Hanks, Inc. of San Francisco.*—ED.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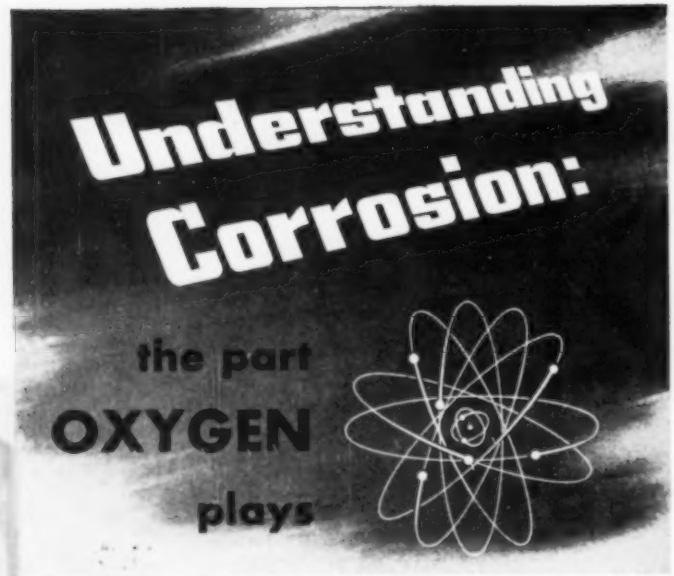


Whether corrosion of metal occurs in moist atmosphere, under water, under ground, or in salt, alkali, or mineral acid solutions, the presence of oxygen is generally the controlling factor. The rate of corrosion depends mainly upon the concentration of available oxygen at the surface of the metal, but is influenced by such factors as temperature, pH, fluid velocity, viscosity, exposed surface area, pressure and humidity of the air, the depth to which the metal is immersed, and the presence of galvanic or other electrical actions.

In air, for example, the humidity becomes a determinant at about 35% and causes a marked increase in corrosion when it exceeds a critical point at 65%. If even minute quantities of corrosive gases are also present, the rate of attack on the metal is further accelerated. In liquid, the rate at which oxygen reaches a metal surface is governed by the velocity of the liquid. In a quiet system with velocity at a minimum, transfer of oxygen to metal is slow and by a diffusion process. Increased velocities increase the rate at which oxygen is brought in contact with the metal and, in turn, increases the rate of metal deterioration.

Getting at the root of corrosion's cause through understanding of the complex factors involved is a first step in control. Some of those factors can be eliminated or regulated. Helping metal get on with those that cannot has long been our specialized field of activity.

Dampney equipment-engineered protective coatings — vinyls, silicones, chlorinated rubber, ceramics, asphaltums — have provided a practical approach to many a difficult corrosion problem. Let us apply that experience to your particular corrosion control needs.

MAINTENANCE FOR METAL

THE DAMPNEY COMPANY

143-1

HYDE PARK, BOSTON 36, MASSACHUSETTS

Idaho—I

Sir:

We have, in our library, copies of *Metallurgical and Chemical Engineering* starting with June 1, 1917, Vol. 16, No. 11. Since this is the year the smelter started operations our records are rather sketchy and do not indicate if the subscription is any older than this or not.

DONALD INGVOLDSTAD
Research Metallurgist
Bunker Hill and Sullivan Mining and Concentrating Co.,
Kellogg, Idaho

Idaho—II

Sir:

Inquiry at the office of Bunker Hill and Sullivan Mining and Concentrating Co. reveals that the company did not, in their early bookkeeping systems, segregate specific publications into a separate account. So they are unable to trace whether or not their *Chem. & Met.* subscription goes back to 1913.

My opinion is that B. H. & S. M. & C. Co., being the oldest and largest bona-fide operator in the district, probably gets the nod. If you adjudged them to be your pioneer subscriber in the Coeur d'Alene mining district I don't think you would be far wrong.

A. Y. BETHUNE
Asst. Superintendent
Electrolytic Zinc Plant
Sullivan Mining Co.
Kellogg, Idaho

South Carolina

Sir:

Your circulation department keeps its books about the way I do. I have been on your subscription list since CE first appeared under its maiden name—and you, Sid, were still in the corn fields of Illinois—I think.

A. M. TAYLOR
Spartanburg, South Carolina

▶ *Yes and a husky 8-yr-old.*—SID.

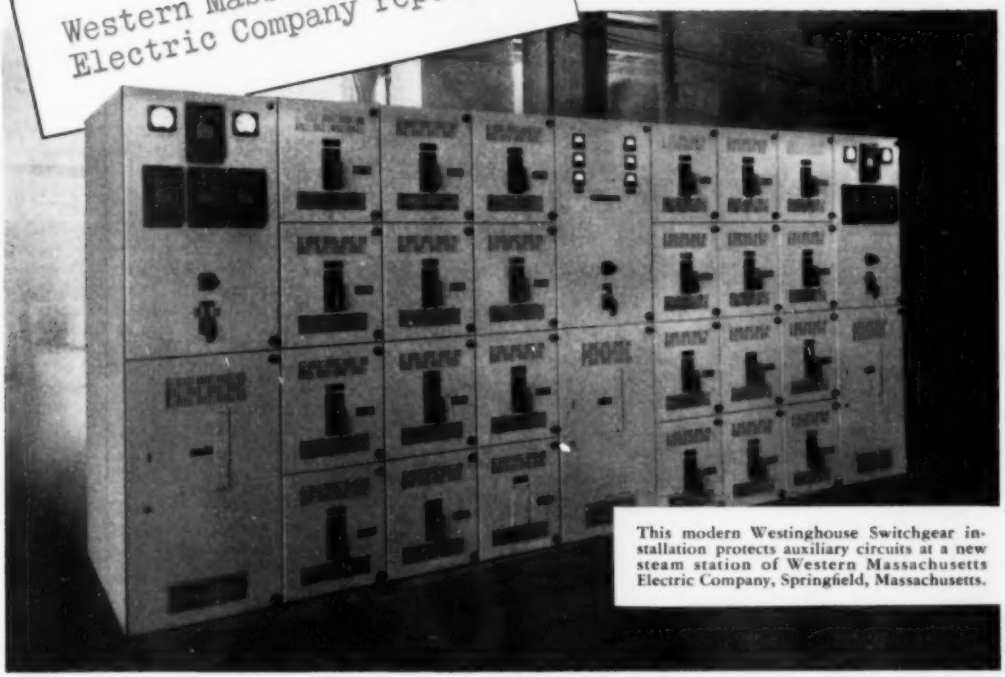
Utah

Sir:

I have been a CE subscriber for more than 35 years. Through the years this important journal of engineering has been a great solace to me since it contained so many articles which touch on the lines in which I have specialized.

A. C. BOYLE
Consulting Engineer
Salt Lake City, Utah

Western Massachusetts Electric Company reports...



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FA is used as:

1. Chemical building block or intermediate
2. Wetting agent for abrasive grains
3. Impregnating agent
4. Solvent for dyes, cellulosic derivatives, resins and coatings.

FA is used in the manufacture of:

1. Resin adhesives
2. Corrosion resistant resins that are useful in tanks, pipes, equipment, floors, smokestacks, cements, and other items where inertness and room temperature setting properties are important
3. Resin binder for fibers.

Literature is available concerning properties and applications of FA. Your inquiry is invited. Now is the time to act.

PROPERTIES OF FURFURYL ALCOHOL (FA*)

Specific gravity, 20/20°C	1.134
Flash point (open cup), °C	75
Refractive index, n 20/D	1.484
Ignition temperature, °C	391
Vapor pressure at 55.5°C., mmHg	5.5

*Reg. U. S. Pat. Off.

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In Australia: Swift & Company, Pty., Ltd., Sydney • In Japan: F. Kanematsu & Company Ltd., Tokyo

Bailey's Thermo—I

Sir:

I am submitting a few comments on the paper by Bailey (Mar. p. 150). . .

The application part of this paper deals with a special field of thermodynamics . . . mainly to space flow of fluids, i.e., flow unconfined by ducts, and to the flow at entrances to nozzles and orifices. Neither of these applications has been of very great interest to the chemical engineer.

The first sections of the paper, where the author deals with fundamental concepts, have very little in them that I consider new or revolutionary. The only thing that is at all new as far as I am concerned is the breakdown of the PdV term into two parts, one representing a change in the flow direction and the other a change in the direction normal to flow. . .

The statement is made, "Classical thermodynamics, now a century old, was developed for static processes and ideal cycles." We are led to infer that almost no one prior to now had applied it successfully to fluid flow or non-ideal situations. This is very far from true. . . Even though Prof. Bailey may have introduced some improved methods of analysis . . . it is surely not true that all the past work on the thermodynamics of fluid flow was based on false premises and that we have to start all over again.

Some of the statements in this section may be true under certain limited conditions which the author does not define. For example, he states that kinetic or internal energy can only change by virtue of changes in Pav (pressure times volumetric flow rate). This is certainly not true in general because internal energy can readily be changed by transfer of heat.

Another example: "A gain in volume + dV represents a loss in internal energy." That this is not always true can be seen by considering the Joule-Thomson expansion of hydrogen. The expanded gas has greater internal energy than the initial gas, and at the same time its volume is also greater.

Prof. Bailey is somewhat remiss in not pointing out that some—perhaps many—of his equations are the same as the ones we have been familiar with for a long time, although the method of derivation may be somewhat different. For example, Eq. (13), which he says "is usually derived from a force point of view," is simply what many of us obtain from the general energy equation by putting in certain special limiting con-

ditions. His derivation . . . tends to conceal what those limitations are but I suspect they are still there.

This paper may present some useful new approaches for solving certain special problems in fluid flow . . . but to state that it . . . introduces "new concepts" is a gross exaggeration and, I fear, may do the author a disservice by casting doubt on what there is in the paper that is a real contribution to certain limited fields.

BARNETT F. DODGE
New Haven, Conn.

Bailey's Thermo—II

Sir:

The core of Prof. Bailey's theory lies in the postulate that the flowing fluid possesses a so-called transmitted energy contribution equal to pressure × area × velocity—in place of the usual potential energy term—in addition to the usual internal and kinetic components. As a definite characteristic of the fluid this does not stand up well thermodynamically. All the developments in the fundamental properties of matter which have been made by physicists and chemists in the last few decades have been solidly based upon the concept that energy existed in one of two forms, kinetic or potential. Hence to eliminate the concept of potential energy and in its place introduce another term is somewhat risky.

If the transmitted energy is considered as a work term, i.e., simply a manner of transferring energy, then it is more plausible. In fact, the term *Pav*, based upon a unit mass of fluid, becomes the conventional *PV* group.

Perhaps the most interesting and important parts of Prof. Bailey's paper are those applied to space flow. These areas are not well known to most chemical engineers.

Chemical engineers are concerned primarily with flow under conditions of friction and turbulence. Prof. Bailey's treatment of these processes in his forthcoming book will be awaited with interest.

J. M. SMITH
Lafayette, Ind.

► *Chemical engineers Dodge and Smith, both authors of thermo books in McGraw-Hill's Chemical Engineering Series, agree in one respect with CE's editorial interpretation of Bailey's ideas (March, p. 242) —that directly and immediately, they won't affect chemical engineering practice much—if at all.*

*As to the fundamental soundness of the new ideas and their long-range implications, we can repeat our prediction made last month and proved, at least in part here, that "the field will soon be rife with debate." Any more of you want to join in?—*ED.

Few other industries require the painstaking supervision, accuracy, or sanitation that is necessary in the production of drugs used to perform "everyday miracles." Yet in spite of this, each of the companies whose trade mark is shown above, day after day, year after year, produces pharmaceuticals that *never meet anything less than the highest standards of purity.*

Of course, the plants operated by these companies are models of precision, planned to achieve the greatest possible efficiency with the finest equipment available. That's why, in each of these plants, you will find Sparkler filters handling difficult liquid filtration jobs.

It is important to remember that Sparkler filters were designed with the same goals in mind — accuracy and sanitation — that are accepted as a fundamental part of the drug industry. They utilize the patented Sparkler horizontal plate principle to provide firm support for the filter media and filter aid. This horizontal surface permits the formation of a stronger, completely uniform cake that will not slip or crack even under intermittent operation. Thus, filtration quality through the entire cake is constant, and can easily be regulated by varying the cake density.

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For full information, write to Mr. Eric Anderson. New catalog is available on request.

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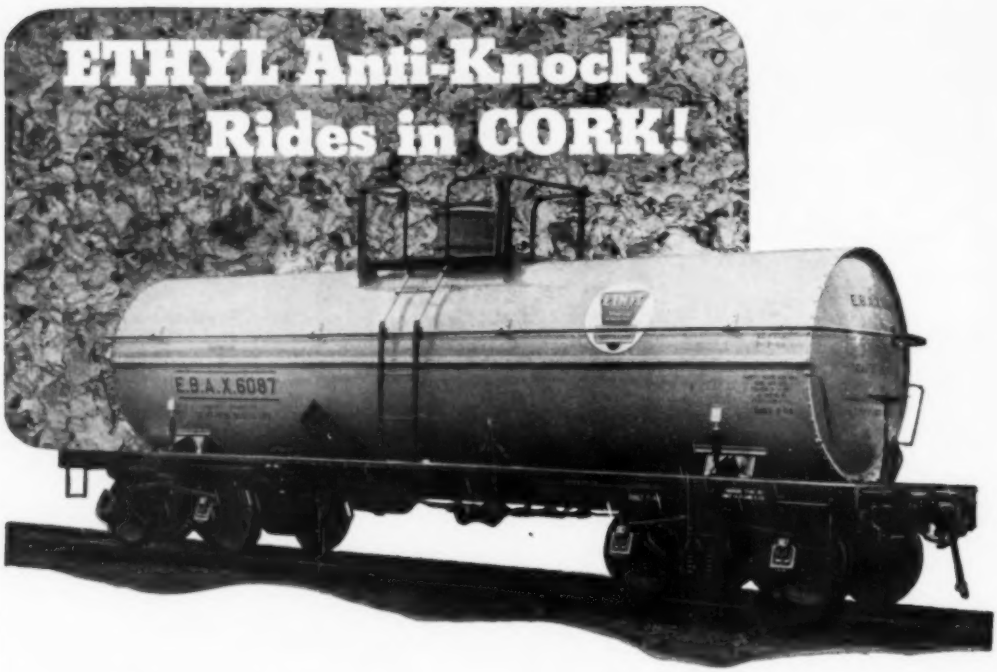

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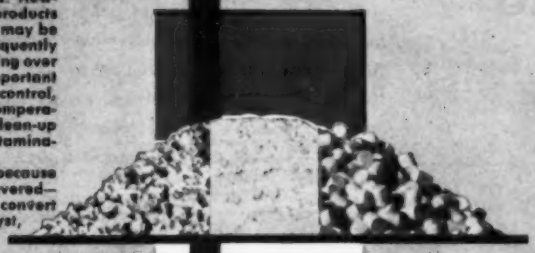
To the uninitiated it must seem paradoxical that platinum metals as catalysts should in so many procedures prove considerably more economical than base metals and oxides. However, even in large-volume products the cost of platinum catalysts may be only *pennies-per-ton!* This frequently represents a considerable saving over other materials, plus many important advantages in operational control, use at low pressures and temperatures — avoidance of costly clean-up procedures to obtain a contamination-free product.

Cost is low as you know because the platinum metals are recovered — and Baker has the facilities to convert recovered metal to new catalyst, economically.



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RESISTS HOT ACETIC ACID and CHLORIDE VAPORS

AT 158 TO 284 DEG. F.

HASTELLOY alloy expansion joint

This HASTELLOY alloy C expansion joint is constantly exposed to acetic acid vapors saturated with acetyl chloride and containing small amounts of chloracetic acid. Alloy C is practically unaffected by these corrosive vapors at temperatures of 158 to 284 deg. F. Used at the top of a 24-foot distillation still, the joint is also elastic enough to compensate for the almost half-inch growth of the heated tower.

HASTELLOY alloy C and the other two grades of this nickel-base alloy—alloys B and D—are excellent construction materials for all types of processing equipment that must resist corrosive attack. In addition to their unusual corrosion resistance, alloys B and C have high mechanical strength and are available in both cast and wrought forms. Alloy D is available in cast form only. All three alloys are readily fabricated by most common methods. Fill out the handy coupon below for the whole story on these alloys.

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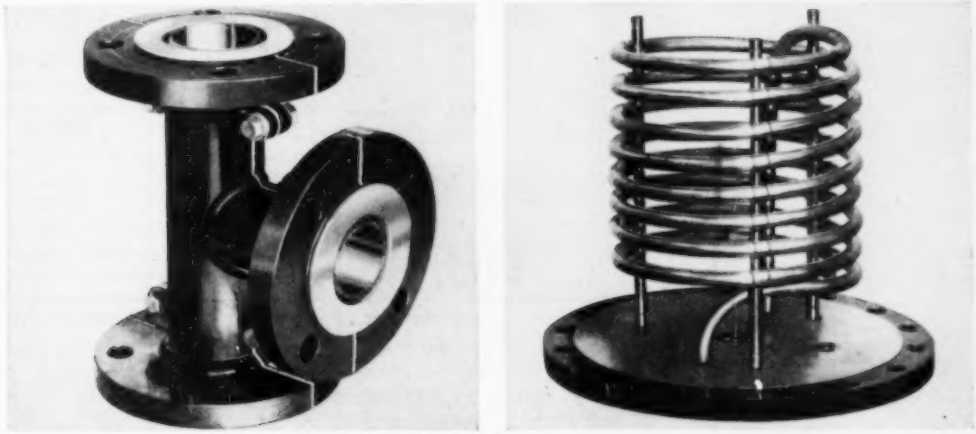


Tantalum tee with steel jack (left) and tantalum coil on a steel flange protected by a tantalum tube sheet (right).

Tantalum

For your files: the corrosion resistance of tantalum, which is used extensively in heating coils, bayonet heaters, coolers, and condensers.

ALLAN L. PERCY

Fansteel Metallurgical Corp., North Chicago, Ill.

Tantalum is an elementary metal, made by powder metallurgy techniques, and in chemical plant equipment tantalum is used in pure form rather than in alloys. Its physical properties are generally similar to those of mild steel, except that its melting point, 2,996 deg. C. is much higher. Unlike most metals of high melting point, tantalum is quite ductile and malleable, and is cold worked into a number of intricate forms. It can be bent, formed, stamped, deep drawn and spun by only slight modifications of conventional techniques. It can be machined, although there is some tendency to gall and tear. Tantalum can be welded to itself by resistance welding, by a special submerged arc welding process, and by the inert gas arc welding method.

Available forms of tantalum include sheet, plate, foil, rod, bar, wire, ribbon, lap welded, arc welded or seamless tubing, special shapes and fabricated products and parts.

As a material of construction for chemical operations, tantalum finds its principal uses as a material for heat transfer equipment in heating coils, bayonet heaters, coolers, condensers, absorption plants and instrument bulb protection. Tantalum equipment of this kind has proved economical in applications of an extremely corrosive nature where no other metallic material—not even gold or platinum—could be used.

The chemical properties of tantalum can be stated briefly—they closely resemble those of glass. Tantalum is rapidly attacked by hydrofluoric acid, or by strong hot alkalis. It is also attacked by fuming sulphuric acid or other substances containing free SO_3. In a lesser degree, tantalum is attacked by hot concentrated sulphuric or phosphoric acid, although there are commercial applications where tantalum has shown satisfactory long life with these materials.

To virtually all other acids or acidic salts, organic or inorganic, tantalum is inert.

In the accompanying graphs, the resistance of tantalum to a number of reagents is shown in symbols expressing inches of penetration per year. Since the tantalum used in chemical operations is usually supplied in wall sections of 0.013 to 0.020 in., the use of tantalum is seldom recommended with a material which would corrode tantalum at the rate of 0.005 in. or more per year.

No attempt has been made in the graphs to state the resistance of tantalum at temperatures above 300 deg. F. Although tantalum is used successfully in a great number of applications at higher temperatures, it is prudent to make tests in each individual case.

Notice . . .

This is the fifth in a series of chart data presentations giving corrosion data for various materials of construction vs. a number of corrosives. Data for the corrosives of particular interest to you will be increased as the coverage grows to include all of the major materials of construction.

Coming:

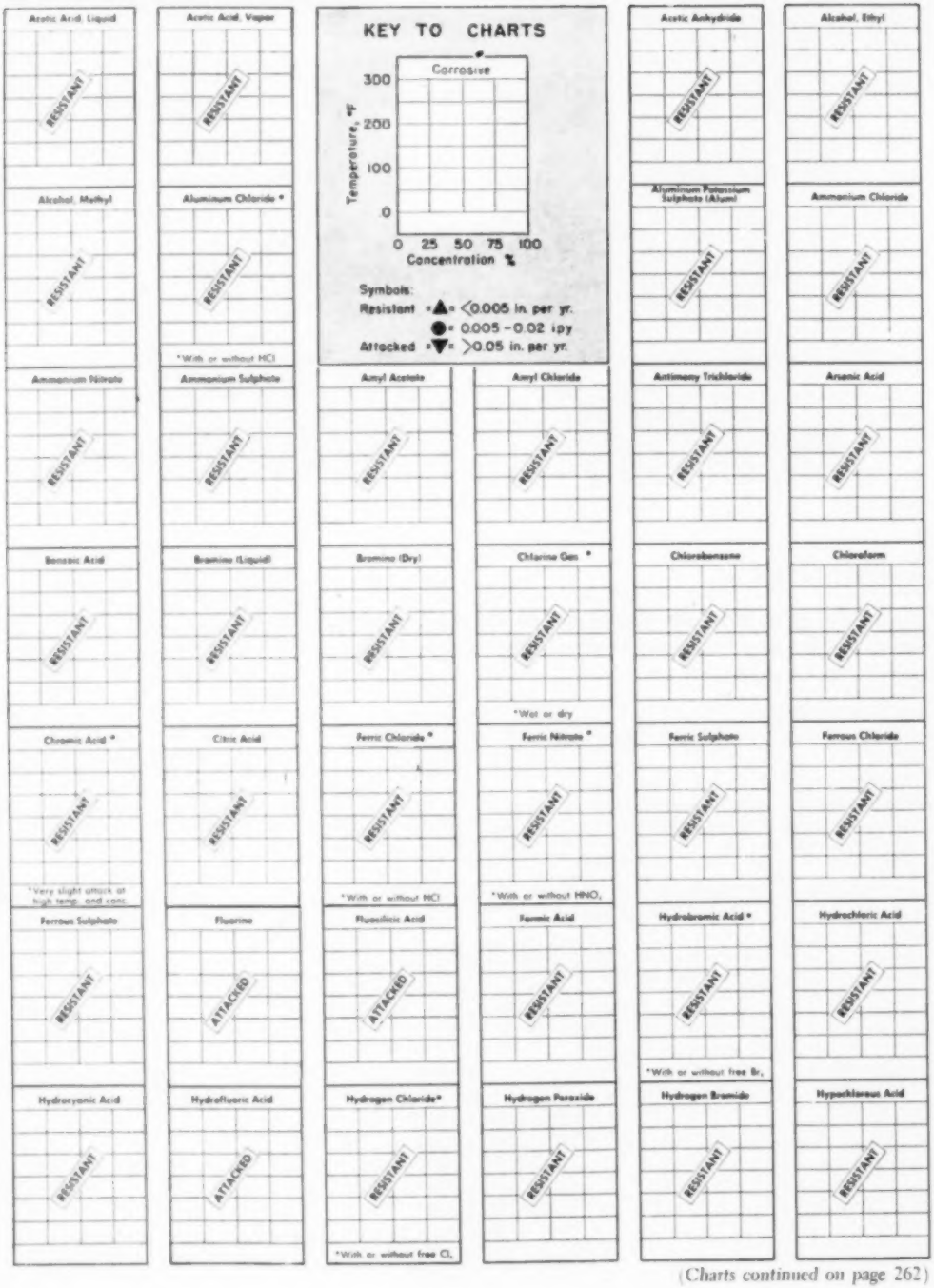
Aluminum, May 1952
Hastelloy C, June 1952

Already Published:

Furane Cements, December 1951
Phenolic Cements, January 1952
Sulphur Cements, February 1952
Silicate Cements, March 1952

Reprints of those already published are available at 25c. each. Address Editorial Dept., Chemical Engineering, 330 West 42nd St., New York 36, N. Y.

Corrosion Resistance of Tantalum



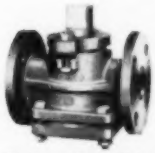
(Charts continued on page 262)

Research keeps DURCO first with the best in corrosion resisting equipment

DURCO design developments and research in materials of construction make possible new ways to handle corrosives. Constant progress in manufacturing techniques makes these new developments of practical use to you.

A good example is the DURCO Type F Valve shown on this page. The use of the Teflon sleeve—and the design which permits its use—gives you a sturdy valve built for tough chemical service.

Other DURCO products help to prove this point. We'll send a catalog on request. But the important thing to remember is this: DURCO *standard* products may easily solve your *specialized* corrosion problems. Let our sales engineers show you how.

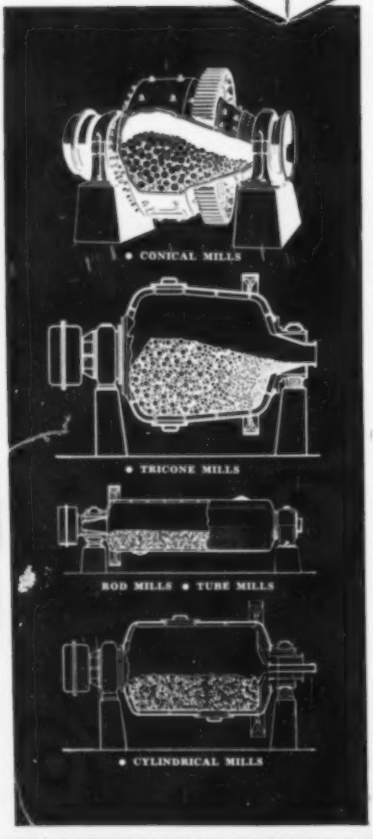


The Durco Type F Valve

THE DURIRON COMPANY, INC.
Dayton 1, Ohio

DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

IS GRINDING YOUR PROBLEM?



HARDINGE MILLS

CONICAL MILLS
—The Hardinge Conical Ball (or Pebble) Mill is unequaled in efficiency. Grinds wet or dry, in open or closed circuit. Outstanding feature: natural size segregation of grinding media, from feed to discharge. Bulletin 17-B-11 for dry grinding; Bulletin AH-389-11 for wet grinding.

TRICONE MILLS
—Same ball segregation effect as obtained in the Conical Mill, plus additional grinding volume. Ideal for large capacity operations. Bulletin AH-414-11.

ROD MILLS
—Ideal for producing minimum oversize in open circuit grinding. Grinds either wet or dry. Convex heads reduce friction, prevent congestion of charge at the ends, and align the rods. Bulletin 25-B-11.

TUBE MILLS
—For a fine product in open circuit without the use of classifiers. For mixing and grinding to secure a smooth texture or plastic product. Bulletin 18-A-11.

CYLINDRICAL MILLS
—The Cylindrical Ball (or Pebble) Mills have demountable trunnions, and convex heads to reduce head liner wear and increase mixing action. Supplied with or without grates, as required. Bulletin AH-389-11.

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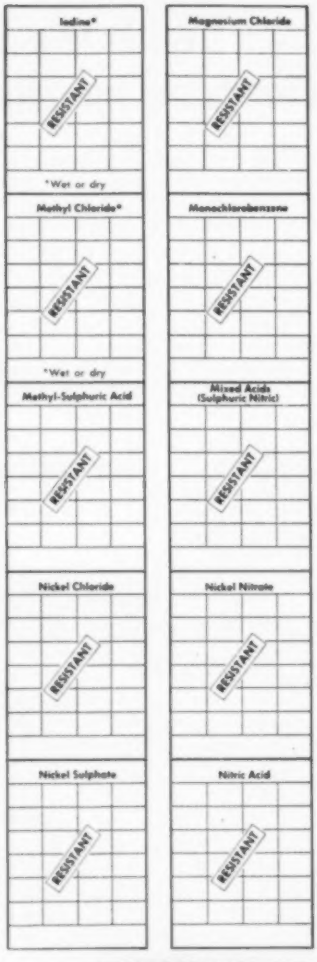
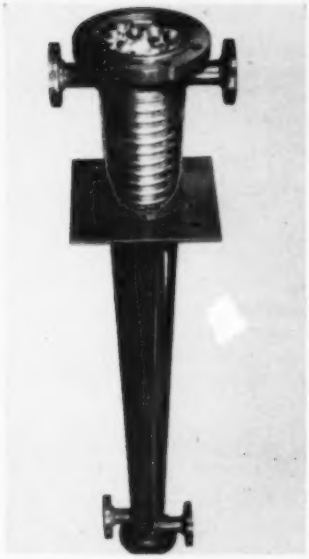
122 E. 42nd St. 24 California St. 205 W. Wacker Dr. 2016 First Ave. 200 Bay St.

Tantalum (key on p. 260)

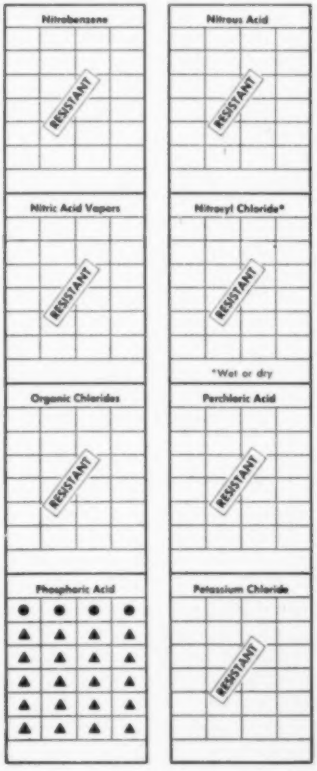


Tantalum expansion joint for hot acids.



Tantalum condenser—steel water jacket.

Tantalum (key on p. 260)



(Continued on page 264)

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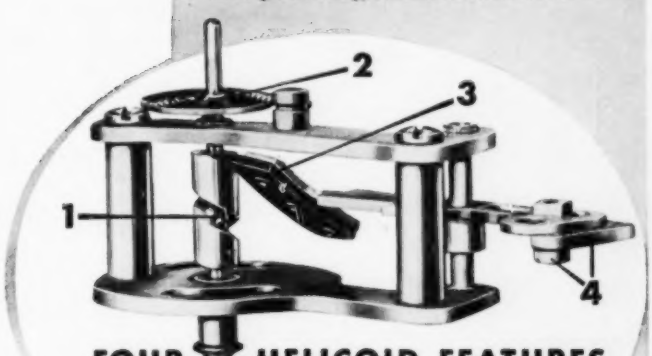
HELICOID

The gage that retains its original accuracy longer, lasts longer, costs less per gage, per year

The greatest achievement of the gage makers' craft—pressure gages without gears. The Helicoid movement... tested and proved in years of hard service... is a simple cam and roller arrangement that gives long, trouble-free service.



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2. Stainless steel hair spring
3. Long Life Cam (no gear teeth)
4. Hardened Monel link and screws

• HELICOID GAGES, which do not have gear teeth to wear out, are made in a full range of pressures... in various sizes and shapes, with black, white and radiant faces. For wall or stem mounting, flush or panel mounting, or flangeless. No finer gages are made. Helicoid Gages cost less in the long run.

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to solve your moisture problems quickly, easily, permanently

Kemp Dryers built to bring YOU *best* in low-cost moisture control

3 BASIC DESIGNS AVAILABLE*

ORIAD—Dries air used to actuate tools, valves, instruments, etc., where drying requirements are moderate.

RADIATION COOLED—For small or medium flow rates. Offer low operating cost with maximum efficiency.

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*All of above in complete range of sizes with manual, semi-automatic or fully automatic operation.

Whether you dry air, gases or liquids, Kemp's superior design and engineering know-how is your best guarantee of a *dependable, low-cost* drying operation. It's a matter of record that many Kemp users are drying air, gases and liquids for *as little as ¼¢ per mcf*. This amazingly low price includes all charges for labor, capital investment and materials. And of course, every Kemp Dryer carries Kemp's guarantee of performance to meet *your* specifications.

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Steam, electric or gas regeneration is standard equipment with every Kemp Dynamic Dryer . . . with or without cooling units. Also, depending on your needs, you have a choice of manual, semi-automatic or fully automatic operation. In every instance, Kemp will specify the proper desiccant suitable for your operation. Chances are there is a standard Kemp design that is ideal for your plant and saves you money too.

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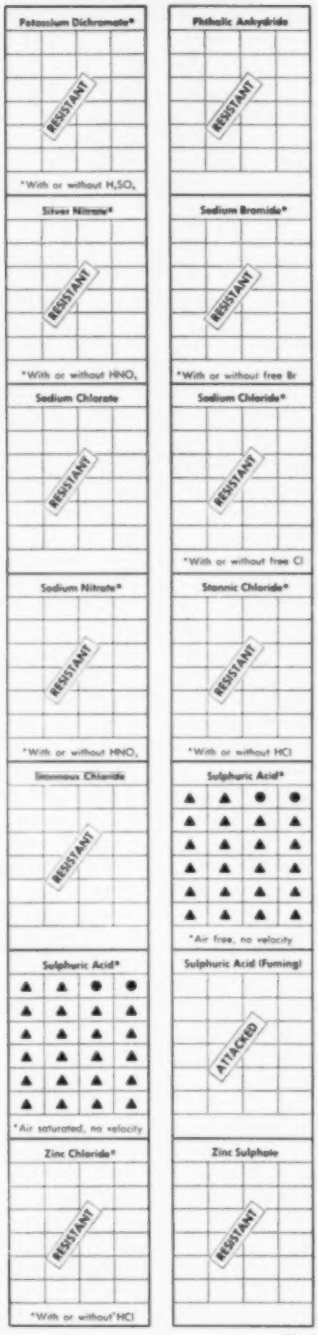
DYNAMIC DRYERS

For technical information and facts on how Kemp Dryers can solve your moisture problems, write for Bulletin D-27 to:

THE C. M. KEMP MFG. CO.
405 E. Oliver St., Baltimore 2, Md.

Tantalum (key on p. 260)



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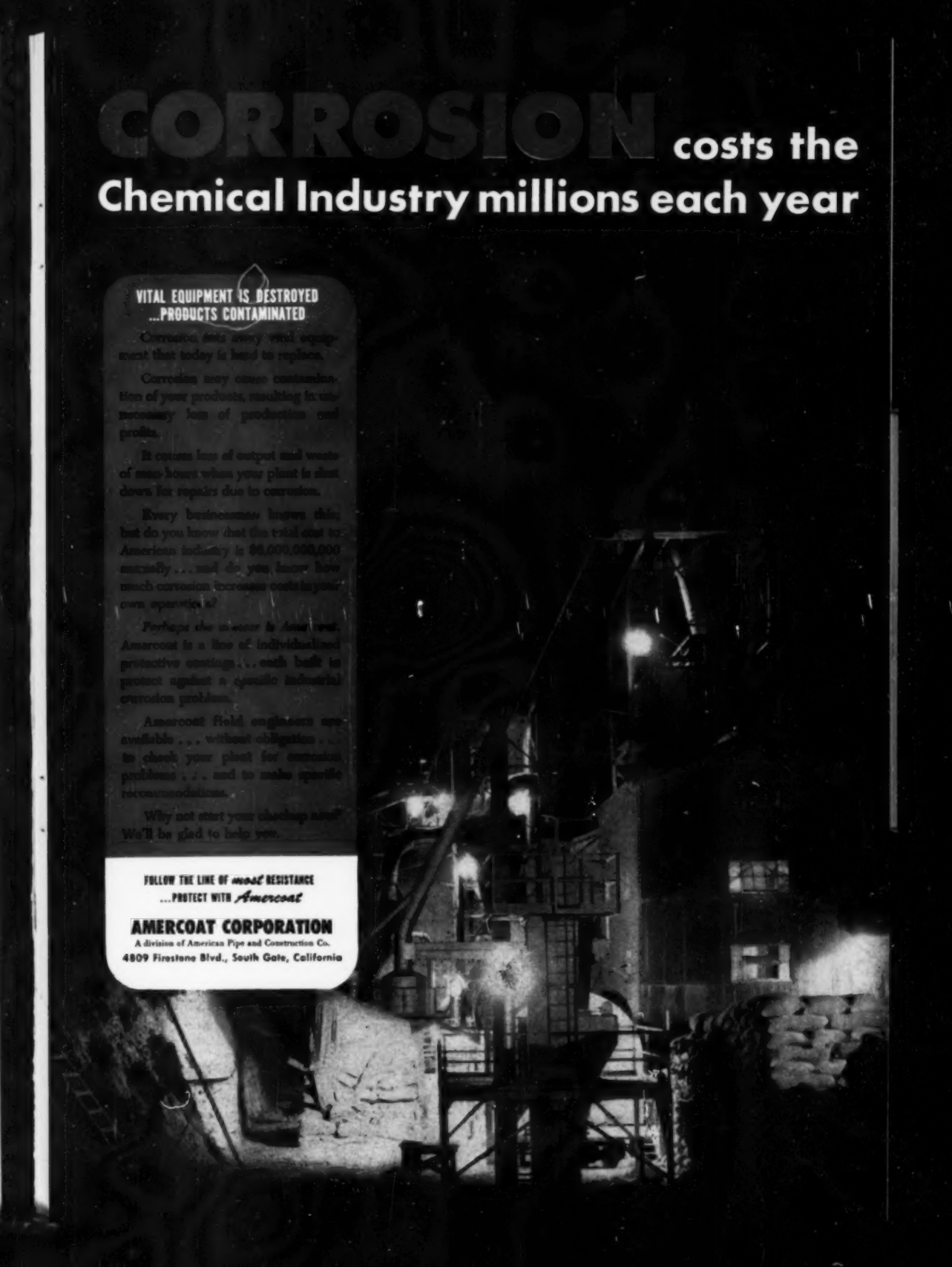
CORROSION costs the Chemical Industry millions each year



VITAL EQUIPMENT IS DESTROYED ...PRODUCTS CONTAMINATED

Corrosion eats away vital equipment that today is hard to replace.

Corrosion may cause contamination of your products, resulting in unnecessary loss of production and profits.

It causes loss of output and waste of man-hours when your plant is shut down for repairs due to corrosion.

Every businessman knows this, but do you know that the total cost to American industry is $6,000,000,000 annually ... and do you know how much corrosion increases costs in your own operation?

Perhaps the answer is Amercoat. Amercoat is a line of individualized protective coatings ... each built to protect against a specific industrial corrosion problem.

Amercoat field engineers are available ... without obligation ... to check your plant for corrosion problems ... and to make specific recommendations.

Why not start your checkup now? We'll be glad to help you.

FOLLOW THE LINE OF *most* RESISTANCE
...PROTECT WITH *Amercoat*

AMERCOAT CORPORATION
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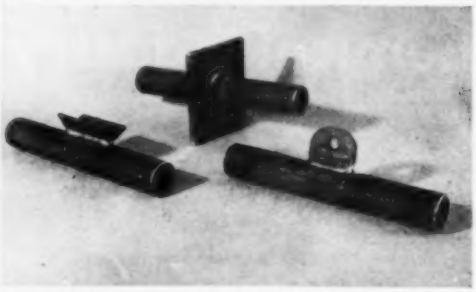
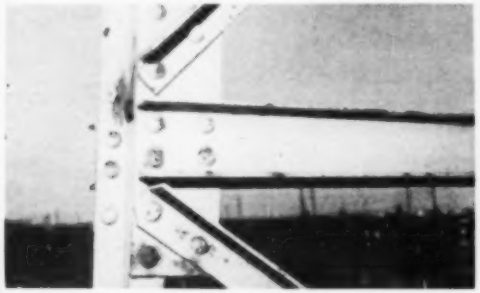
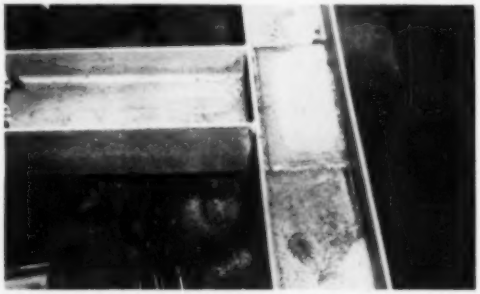
Conventional . . .

Cleanable, Paintable . . .



Typical pipe hanger installation with paint partly chipped off (left) and welded on hangers for easy access (right).





Section of A-frame for a typical pipe trestle of riveted construction (left) and section of an all-welded A-frame (right).

Built-In Corrosion Prevention

Best way to solve a corrosion problem is to eliminate it, says L. B. Woolfenden—plant engineer at General Aniline Works, General Aniline & Film Corp., Grasselli, N. J.

In his talk before the Plant Maintenance Conference, Philadelphia, Jan. 14-17, Mr. Woolfenden told about the following corrosion problems that were eliminated by re-designing to get cleanable, paintable surfaces:

Outdoor Pipelines—Corrosion of outdoor pipelines at hanger supports is usually more severe than elsewhere on the line, and the life of the whole pipeline is reduced by the failure at these hangers. This is caused by the accumulation of dirt, chemicals and moisture between pipe and hanger. Painting couldn't solve the problem, since the area under the hanger could not be reached.

A solution was to weld a $\frac{3}{8}$ in. flat iron about $1\frac{1}{2}$ in. × 3 in. onto the pipe and burn a hole through it for the hanger support. The entire exposed surface of the pipe is then exposed for cleaning and painting, and will last as long as the rest of the pipe.

Pipe Trestle—Another example was a pipe trestle, designed some time ago, which had every possible obstruction such as rivet heads, pockets, angles, and diagonals combined to make cleaning and painting a nightmare.

On recent additions to the trestle, the design department has come up with a streamlined version. This all-welded structure has a minimum of area with maximum accessibility and, consequently, a much better, longer-lasting paint job can be done.

Design has also eliminated an impossible cooling coil problem by eliminating the cooling coil entirely and cooling by vacuum evaporation instead.

The structural squad has similar problems in preserving the building structure itself. Corrosion on steel sash has been eliminated to a great extent by substitution of glass block, wood and aluminum sash.

Corrosion of structural steel members has been reduced by a good painting job before being encased in brick or concrete.

Scarce Alloy Saved by Improved Construction

Desirable savings in nickel and other critical alloy materials can be accomplished by new methods in design and construction of industrial furnaces, according to Kenneth W. Stookey, president of The Gas Machinery Co. of Cleveland.

Elimination of scarce nickel and chromium can be made in two ways: (1) redesign, and (2) material substitution. The design method is to meet heat treating specifications with furnace construction not requiring the critical alloy materials necessitated by earlier designs. An example would be employment of rotary furnaces for forging and heat treating compared to the pusher type. Rotary furnace

paper sculpture by Brenda Lynn

ONE JUMP AHEAD

research to explore the potentialities of its present products and to develop allied products to serve its customers... this is the secret of NIAGARA's position among the leading producers of quality electro-chemicals.

NIALK®	Liquid Chlorine
NIALK	Caustic Potash
NIALK	Carbonate of Potash
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NIALK	TRICHLORethylene
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Here's the Seal
To Solve Your
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"JOHN CRANE"
MECHANICAL SEAL
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The John Crane Type 9 Seal is designed to meet corrosive and high temperature conditions. That's because its flexible wedge and sealing rings are molded of the spectacular new plastic, Teflon, which is not affected by any industrial chemical, including solvents.
This revolutionary seal is the successful development of two years research and field testing. It's a perfect blend of John Crane experience in designing mechanical seals with the unique properties of Teflon: chemical inertness, extremely low friction and high heat resistance. Type 9 Seal can be employed at temperatures up to 500° F.
The result is a new, efficient way to handle corrosive liquids and gases that never before could be effectively controlled by conventional, flexible-type mechanical seals.
MIXER AGITATOR
PUMPS
SPEED REDUCER
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Prevents Leakage of:
EXPENSIVE CHEMICALS
INFLAMMABLE LIQUIDS
TOXIC GASES
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SOLVENTS
Other John Crane Teflon Products include expansion joints, C-V Rings, packings and gaskets. Also, parts molded or machined to your particular requirements.
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construction needs only refractory and moderate quantities of carbon steel. Incidentally, rotary furnaces require less investment for the same duty and some metallurgists consider results to be superior. Rotary furnaces were given an opportunity to prove themselves during World War II and have continued to excel in more recent installations.

Other furnace applications do not lend themselves to complete redesign but are adaptable to substitution of materials. One instance is use of silicon carbide in roller hearth furnaces, replacing alloy steel. Here again, advantages are gained beyond just the saving in critical materials. Silicon carbide rolls will counteract the black spots, welding tendency, warping and other difficulties experienced with steel rollers.

Corrosion in Action

A new sound color film, prepared under the direction of the Corrosion Engineering Section of The International Nickel Co. was shown for the first time on March 11 at the annual conference and exhibition of the National Association of Corrosion Engineers at Galveston, Tex.

Entitled "Corrosion in Action," this sound color film shows how corrosion works to cause an annual loss in industry and elsewhere estimated at over $6 billion. It also shows how this damage can be avoided or controlled by various means, such as by the selection of corrosion-resistant materials, by the development of new alloys to meet given situations, by the use of electric currents to provide cathodic protection, and by other methods.

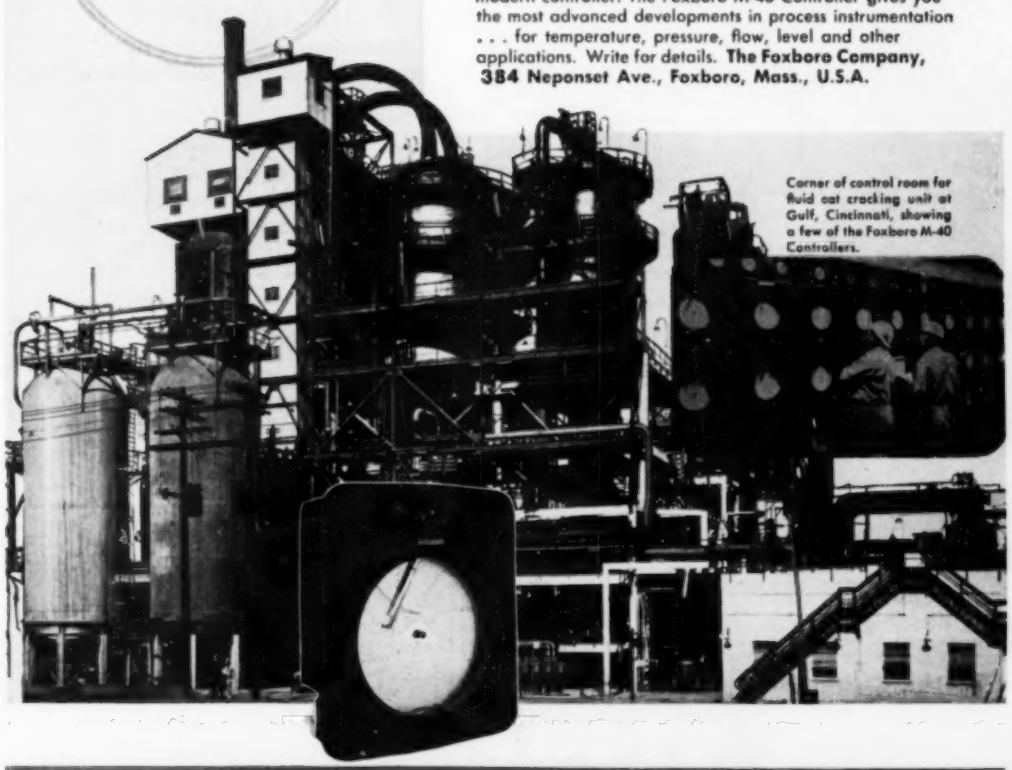
Almost every technique known to the motion picture industry was used in the filming of the picture, including animated drawings, slow motion dissolves and time elapse photography. Films were made at the testing stations at Kure Beach and Harbor Island, N. C.; in industrial plants in various parts of the country; and elsewhere. The film took approximately a year to produce.

"Corrosion in Action" was made essentially for technical, educational and industrial groups, though its treatment is such that it can be understood by non-technical audiences. It will be released for use in schools, colleges, industrial plants, and before technical societies. Bookings can be made through the Corrosion Engineering Section, The International Nickel Co., Inc., 67 Wall St., New York 5, New York.

GULF'S NEW CAT CRACKER
demonstrates why refineries prefer Foxboro M-40 controllers

The ultra-modern fluid catalytic cracking unit at Gulf Oil Company's 28,000-barrel Cincinnati Refinery offers another example of the consistent performance that has won the petroleum industry's confidence in Foxboro M-40 Controllers. For this exacting new process, M-40 Controllers were selected because of their previous performance at Gulf . . . "an outstanding record of high accuracy, reliability, ease of maintenance and freedom from variation." In the 2 years since their installation at Cincinnati, they have continuously maintained this record!

Gulf, Cincinnati, is only one of many leading refineries that base their control systems on M-40 . . . the finest modern controller. The Foxboro M-40 Controller gives you the most advanced developments in process instrumentation . . . for temperature, pressure, flow, level and other applications. Write for details. **The Foxboro Company, 384 Neponset Ave., Foxboro, Mass., U.S.A.**

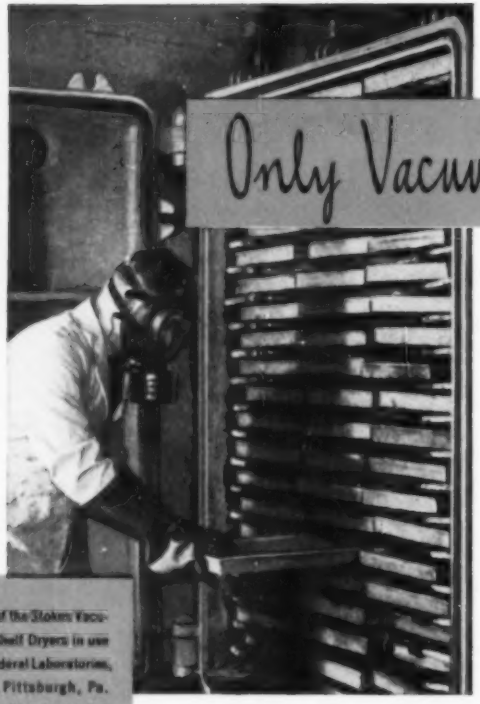


Corner of control room for fluid cat cracking unit at Gulf, Cincinnati, showing a few of the Foxboro M-40 Controllers.

FOXBORO REG. U. S. PAT. OFF. **M-40 CONTROLLERS**

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

Only Vacuum dries to 0.35%



One of the Stokes Vacuum Shelf Dryers in use at Federal Laboratories, Inc., Pittsburgh, Pa. Operators wear gas masks when removing trays of the tear gas crystalline solids processed in Stokes Dryers.

In the manufacture of tear gas, a crystalline solid is produced, the moisture content of which must be reduced to 0.35% without permitting the volatile solid to sublime as an irritant gas.

Vacuum drying of tear gas solids is done by Federal Laboratories, Inc., Pittsburgh, Pa., in Stokes Vacuum Shelf Dryers at 100° F. A vacuum of 2 to 10 microns is used to achieve the desired dryness while maintaining safe working conditions.

Trouble-free service by Stokes equipment in Federal Laboratories assures constant high production of the active material for tear gas devices used by police and military.

Many materials which are sensitive to heat, evaporation or oxidation, and which cannot be agitated, are best processed in Stokes Vacuum Shelf Dryers. Chemical salts, dyes, food extracts, glues, rubber and explosives are typical products which can be dried safely, rapidly and economically in vacuum at low temperatures.

Available in many capacities, Stokes Vacuum Shelf Dryers are designed for drying products which must not be agitated or require no mixing.

See Stokes — the only manufacturer of complete vacuum processing systems — on your present vacuum processing problems or arrange for tests in the Stokes semi-plant-scale laboratory.

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Plastics Molding Presses,
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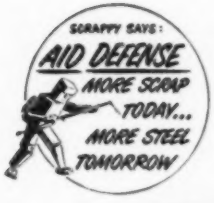
Grandpa Never Threw a Thing Away



It's only human to want to hold on to things after they've outlived their usefulness. That's why today millions of tons of worn-out and obsolete equipment and machinery are lying forgotten in the country's plants and factories and on farms.

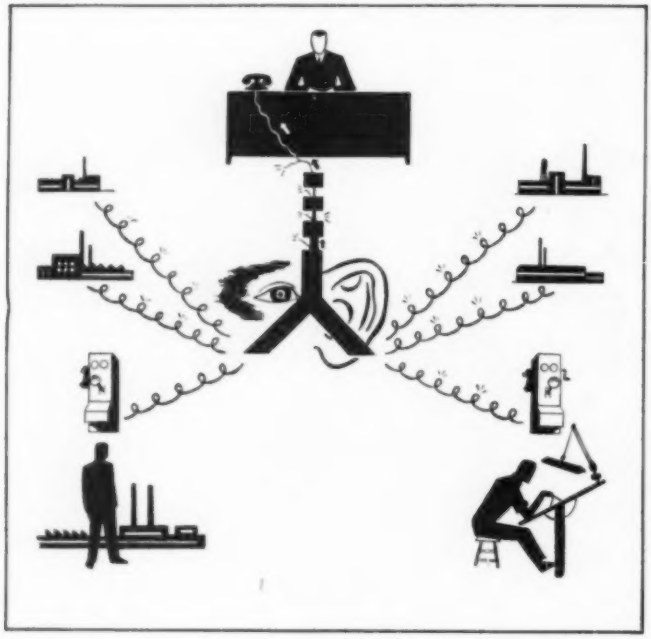
The steel industry needs these millions of tons of dormant scrap, needs it in the worst way. With this vital dormant scrap the entire steel supply picture would brighten up, with more steel for everybody. But without it, the steel industry cannot hope to keep up production at present levels.

Call in a scrap dealer now, today. He will buy your dormant scrap and start it moving toward the steel mills.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

More Scrap Today... More Steel Tomorrow



Management Wants Better Lines Of Communication to Engineers

The boss wants to exchange ideas with his engineers about running the business but too often someone's apathy is cutting the lines of communication.

You may have thought otherwise but the people who run engineering companies are darned interested in keeping in touch with their engineers. They want suggestions on everything from strictly engineering matters to customer services and employee training. They also want to be sure that their engineers get to know about such things as the competitive standing of their company and personal opportunities for advancement. But present methods of communication, both up the line of supervision and down, are often inadequate.

In fact, a poll of major industrial employers of engineers named communications one of the top problems facing engineering corporations today. In order to get a clear picture of the situation, the National Society of Professional Engineers set out to study the problem.* They contacted 350 firms in all industries employing engineers. Of these, about 50 replies came from chemical processing industries.

Here are some highlights of the results of their study.

HOW COMMUNICATIONS SYSTEMS WORK

In most companies, the communications program is centered around the chief engineer. As the man in contact with top management on one hand and all the rest of the engineering employees on the other, he controls communication in both directions. He also determines how much each engineer will participate in company planning. So the communications pattern takes the form of an inverted "Y," with the chief engineer at the junction to relay information up and down the line.

The difficulty with this system is that the chief engineer is either not aware of his responsibilities or he is too busy to do anything about them.

For instance, during the survey, one vice president of engineering for a major company said, "How can I still keep in personal touch with all of our engineering departments with the amount of work I now have? I've just discovered that one of our plants is still pinning hopes on a program that headquarters lost interest in six months ago. I would like to talk to all of our folks but just can't."

The survey indicated that the solution to the problem was to educate everyone, top management, chief engineer, project engineer and the engineering staff, in the mechanics of the communications procedure and to impress everyone with his responsibility of getting information through.

The poll, next, tackled the questions, does management seek the opinions of its engineers? If so, how does it get them?

MANAGEMENT NOT SATISFIED

A majority of companies, 88 percent, replied that they certainly did want suggestions from their engineers. However, nearly half of the companies said that they were not satisfied with their present methods of communication. Forty percent of the managements interviewed got their engineers' suggestions from conferences. Meetings accounted for 32 percent; interviews, 15 percent; and surveys and suggestion boxes contributed 9 and 4 percent respectively.

The survey asked if managements thought their present methods of seeking opinions were as successful as they would like them to be. A slight majority, 55 percent, said "yes," and 45 percent said "no." As a corollary question, the survey asked for opinions on how present methods could be improved. A few of the answers:

- By engineers developing their perspective on economics, labor relations and sales problems relative to their industry.
- Better communications between top management and engineering department as to plans and objectives.

(*Continued on page 274*)

*"How to *Improve Engineering-Management Communications*, available from the Society, 1121 15th St., N.W., Washington 5, D.C., at $1 to members, $2 to non-members.

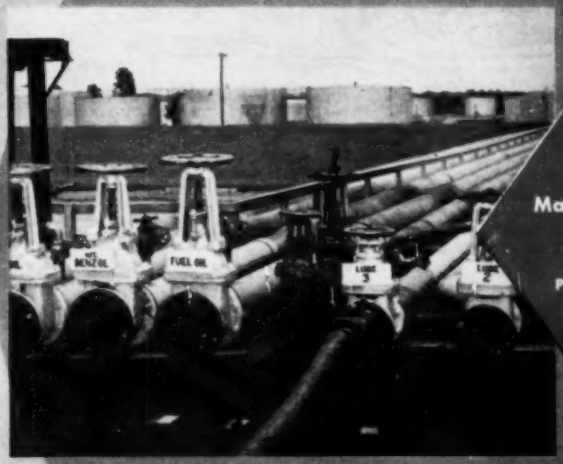
clean or dirty

clean or dirty

clean or dirty

clean or dirty

clean or dirty



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Important Marketing Centers

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General American Tank Storage Terminals handle any chemical or bulk liquid . . . *clean or dirty* . . . that flows through a pipeline! Storage facilities, pipelines and closely guarded manifolds (designed to protect against contamination) are yours to use. At Carteret and Goodhope terminals your bulk liquids can be blended to specification, canned, drummed or barrelled for distribution. ***All this without investing or risking your capital!***

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A Division of General American Transportation Corporation
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NO! CURLEY.. YOU DON'T HAVE TO BUMP THAT EXTINGUISHER!

To operate an Ansul Dry Chemical Fire Extinguisher you simply remove ring pin, push down puncture lever and squeeze nozzle. No bumping is necessary for mechanical breakage of the dry chemical. When Ansul Extinguishers are pressurized, the jet of high pressure gas instantly fluidizes Ansul *"PLUS-FIFTY"*® Dry Chemical.

You want properly designed fire extinguishers . . . designed for maximum effectiveness by inexperienced operators, designed for quick, on-the-spot recharge (no tools needed), designed for easy, economical maintenance. . . . You get all this with Ansul Extinguishers. In addition, you get the best fire extinguishing equipment capable engineers can design and a modern plant can manufacture.

SEE PAGE 189

Syntron F-22 Feeder feeding dried silver nitrate crystals into stainless steel barrels. Each barrel holds $5,000 of the salt-like material that goes into the making of photographic film.

Syntron finger-tip control of flow not only speeds up the operation—but prevents waste of costly material.

SYNTRON

"Vibra-Flow"

VIBRATORY FEEDERS

With Variable Control of Rate of Flow

WILL HANDLE—most types of bulk materials—from light, fine powders to heavy, coarse lumps—hot or cold—dry or damp—abrasive. AT—variably controlled rates from pounds to hundreds of tons per hour. TO—crushers, belts, screens, ovens, blenders, packaging machines, etc. WITH—exceptionally low maintenance costs due to absence of motors, pulleys, eccentrics and other wearing parts.

SYNTRON COMPANY

819 Lexington Avenue Homer City, Penna.

• More conferences and recognition of engineers' general knowledge, not just their technical ability.

• Let lower echelon engineers into the "know" on projects early. Keep them informed on the over-all department program.

The majority of suggestions for improvement express, essentially, the feeling that participation should be broadened and the effectiveness of present programs improved. Since management holds the initiative here, it appears that the stimulation of engineers to apply their analytical talents to thinking about over-all company success depends on the extent to which management executives meet with them personally and discuss company affairs in detail. Inside, advance information "right from the horses mouth" has a great psychological value and, in most cases, will challenge people to come up with the answers.

GETTING INFORMATION DOWN

The other side of the problem, getting information down the line, came in for a good deal of scrutiny too.

First, what company information do engineers seek most? Here is a relative breakdown of topics most asked about:

Opportunities for Advancement	22%
Expansion Plans	17
New Products and Processes Contemplated	14
Technical Trends in Industry	9
Competitive Standing	8
Benefits and Security	8
Sales and Earnings	7
Sales Promotional Activities	5
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Secondly, the questioners wanted to find out how managements get this information down the line.

Most companies, 30 percent, use direct line of supervision to relay information. Twenty eight percent rely on personal talks by executives. Regular engineering conferences are employed by 23 percent of the companies. The rest use either management newsletters, 12 percent, or engineering seminars, 7 percent.

HOW TO IMPROVE COMMUNICATIONS

The last part of the study had to do with recommendations to improve communications. This part cited the case of a leading U. S. firm which set out to find out why ideas didn't flow upward to management as easily as orders flowed down. The blame was laid directly upon management. Discussing the authoritarian attitude of supervisors, the panel studying the

problem noted, "Listening and acting on the basis of what subordinates think, not what we think, is absolutely essential to being realistic in management."

Management often resents comments that imply its actions are less than perfect. If lower echelons know this, loyal employees, or those who want to keep their jobs, are likely to withhold information.

Management tries to dodge the individual personal problems of its subordinates. When it tries to separate the business life from the personal life and feelings of its people it cannot expect understanding or active interest in upward orientation.

Management often fails to heed information or act on unhappy situations. Apathy or disinterest on the part of employees is likely to set in when they find it doesn't do any good to make upward recommendations.

The investigating panel reported that the worst of the problem is solved when management understands that it bears responsibility for poor communications and has the exclusive authority to effect improvements. The first, and essential, step in making improvement is an earnest desire on the part of management to try to understand the interest of its employees as people and to create a climate in which a workable system of communication can flourish.

Assuming management sincerely wishes to improve communications with its engineers it can undertake a project of review and revision including the following steps:

1. Conduct an "Engineering Audit" to determine as accurately as possible how all members of the engineering staff feel about their present communications with management. Once policy is determined for a specific group, a variety of communications techniques and methods may be employed.

2. Review present communications techniques and test their effectiveness. Engineering audit findings will be a pertinent guide as to whether or not present communications methods and media are effective.

3. Have a single top management man responsible for regular engineering-management communications. Usually this man will be the Vice President of Engineering or Chief Engineer who, as the survey determined, is the key figure in the communications network.

The top engineering executive has the greatest stake in the higher productivity of his engineers through the improved morale and more efficient supervision that good communications bring about. —End

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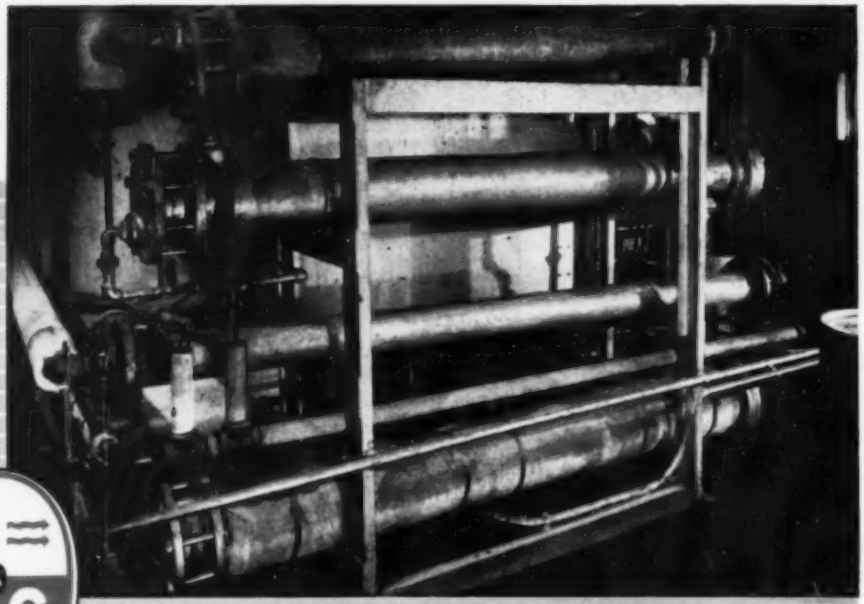

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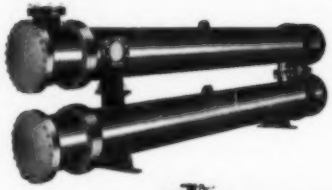

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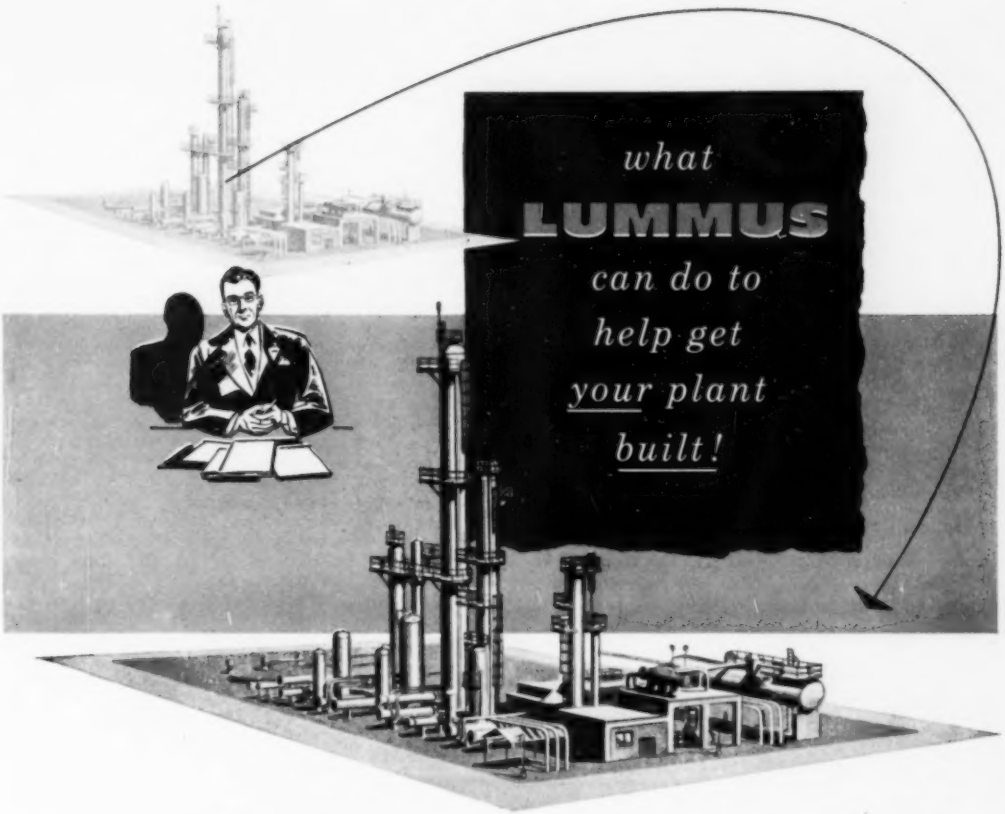

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Names in the News Edited by Frances Arne

MAN OF THE MONTH: John P. Coe

Winner of this year's CCDA Honor Award for outstanding success in the introduction of chemicals to commerce, general manager of Naugatuck chemical.

All the while Naugatuck chemical division researchers are readying a new product for the market, they're aiming at a narrow end-use target. They want to be able to tell the industry exactly what need the product will supply. John Coe, division general manager, feels that this is the key to development and marketing successes.

And he's well qualified to speak of success. Today there is hardly a rubber product made in this country that does not contain some chemical produced at U. S. Rubber's Naugatuck division.

Thoughtful, soft-spoken Coe, who is also a U. S. Rubber vice president, has headed the division since 1939. During the war he directed the nation's largest single rubber plant at Institute, W. Va. He later skillfully guided the company's entry into the agricultural chemicals and vinyl resins fields.

He started with the company fresh from MIT in 1913 at $70 a month. Within a year he had worked on every operation at its Indianapolis tire and tube plant.

He moved on to the general laboratories in New York. During the first World War he worked in Naugatuck and Providence on an improved gas mask for the Navy. Later he was placed in charge of tire development, first at the general laboratories then in the tire division at Detroit. In 1931 he came to Naugatuck, first as plant manager and later as general sales manager.

Today Mr. and Mrs. Coe live on a 106-acre, pre-revolution farm at Woodbridge, N. Y. The farm boasts 200 apple trees, a horse, a tractor and a snow plow.

Coe's other big interests are his four grandchildren, hunting and fishing. He has two pet fishing rods—one of U. S. Rubber's Vibron (polyester resin), the other of plain bamboo.

Allen Latham, Jr. New vice president, Arthur D. Little, Inc. In charge of mechanical developments. With Little since 1941. Developed the Kleinschmidt vapor-compression distillation equipment. Previously with the Land-Wheelwright Laboratories which became the Polaroid Corp. Studied at MIT.

James K. Stanley. From senior projects metallurgist to section head in the materials division, engineering research department, Standard Oil (Indiana). Joined Standard in 1950 after 13 years' service with Westinghouse Electric research laboratories. Doctorate from the University of Pittsburgh.

G. G. Cortelyou. Chief design engineer, General Petroleum Corp.'s engineering department. With the company since 1940. From laboratory work to measurement engineer to job engineer and project engineer. Graduate of California Institute of Technology.

Will F. Sims. New staff member, chemical plants division, Blaw-Knox. **T. F. Montgomery:** to principal engineer of the company's chlor-alkali department. Before joining Blaw-Knox in 1948, chief engineer of a large vinyl chloride resin plant. Lehigh University graduate.

Howard W. Swank. Production manager in the manufacturing division for Dacron polyester fiber, Du Pont. His successor as nylon technical manager: **Edgar H. Bleckwell,** formerly manager of the company's Chattanooga plant. Mr. Bleckwell's successor: **William H. Thalheimer,** formerly manager of the Yerkes rayon plant at Buffalo, N. Y.

Melvin G. Mellon. Winner of the $1,000 Fisher Award in analytical chemistry administered by ACS. Professor at Purdue and authority on the use of color in chemistry.

E. C. Gillett. From chief chemist to technical director, California and Hawaiian Sugar Refining Corp., Crockett, Calif. New assistant chief chemist: **P. F. Meads.**

Bradley Dewey, Jr. Elected a director of Dewey and Almy Chemical Co. Vice president in charge of the Cryovac division. Joined the company in 1940 as a division head in the research laboratory. Later headed the development department. Doctorate from MIT.

A. J. Gracia

J. D'Ianni

A. J. Gracia. Assistant manager of research and development activities, Goodyear Tire & Rubber Co. Affiliated with the office of the vice president for two years. Joined the organization as a staff trainee in 1928 following graduation from MIT. Named manager of the chemical engineering division in 1942. His successor in the vice president's office: **James D. D'Ianni,** previously in charge of research studies on synthetic rubbers and vinyl plastics materials. Joined Goodyear in 1938 as a research chemist. New director of research: **H. J. Osterhof.** New development

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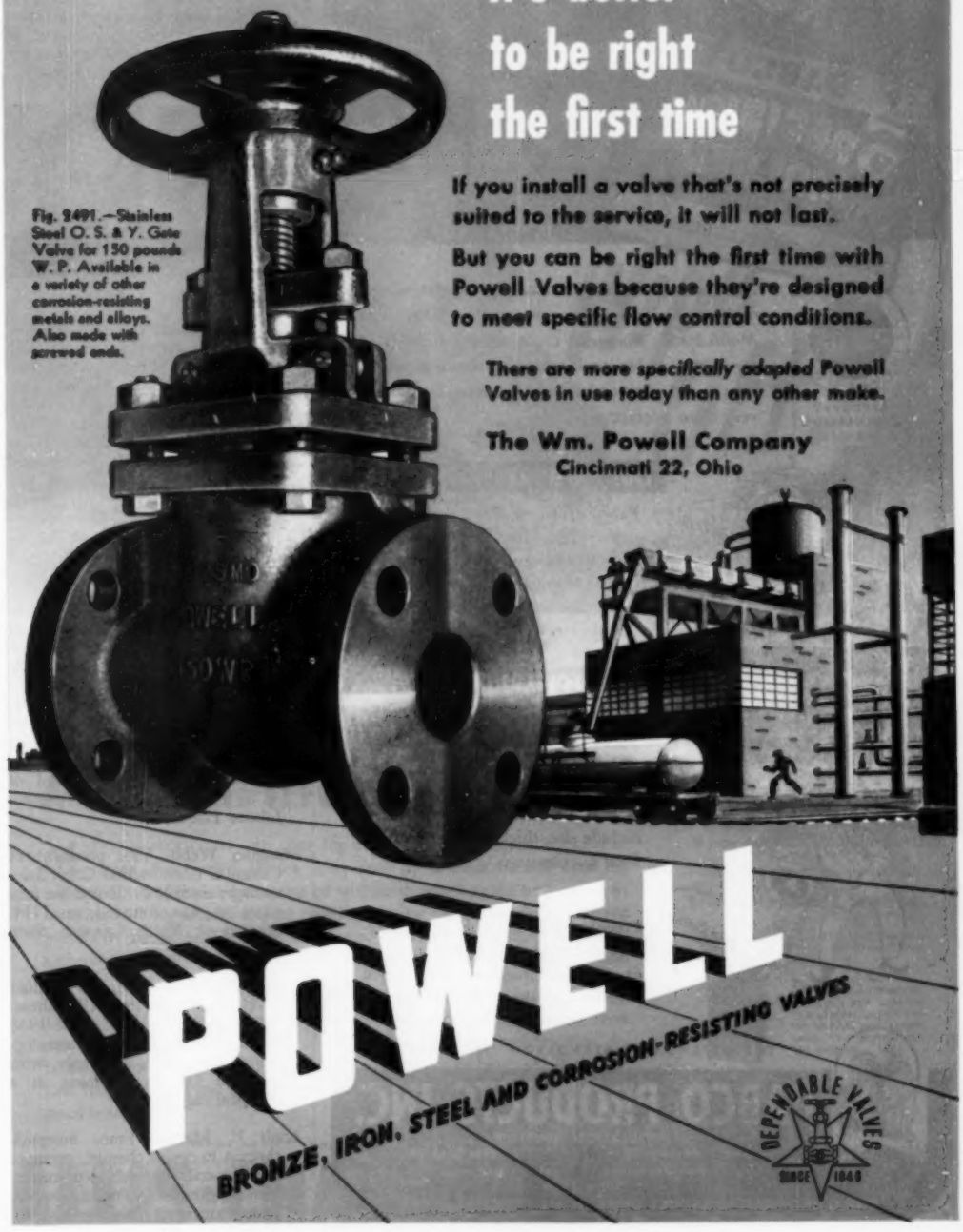

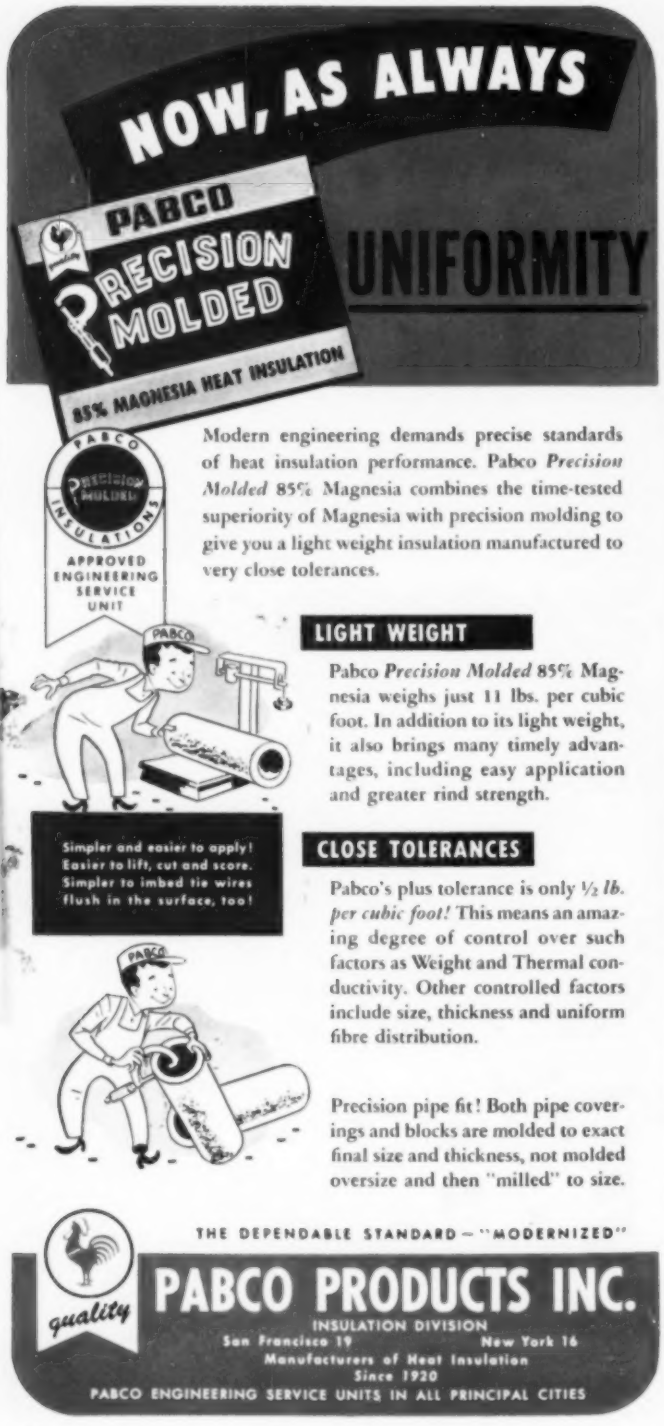
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manager of the tire and compounding division: **W. W. Vogt.**

Martin E. Gilwood. Director of research, Permutit Co. Company history: research engineer, assistant manager of research, manager of chemical research. Chemical engineering graduate of Rensselaer.

M. E. Gilwood

L. McDonald

Louis McDonald. Director, development and control laboratories, Kelite Products, Inc., Los Angeles. Previous employers: National Aniline; Tonawanda Paper Co.; Dodge Chemical Co.; Manhattan Project and U. S. Naval Ordnance; California Institute of Technology. Studied at the University of Virginia and Princeton.

Roy Newton. Recipient of the Industrial Research Institute's medal. Associated with Swift & Co.

Frank H. Spedding. Winner of the 1952 William H. Nichols Medal of ACS's New York section. Director of the Iowa State College Institute for Atomic Research and of the Ames Laboratory of AEC. Studied at the universities of Michigan and California. Previous honors: 1933 Langmuir Award in Pure Chemistry, 1948 Iowa Medal of ACS; 1949 Phi Lambda Upsilon Jubilee Plaque.

Mangum Webb. Vice president of Chemical Construction Corp. Sales manager since 1949. Joined the firm when it was founded in 1914. Studied at North Carolina State College.

Ernest Ohsol. Manager, new product development laboratory, GE's chemical division. With GE since 1950 as manager of the process development laboratory. Previously with Standard Oil Development as a chemical engineer.

Louis E. Marchi. From inorganic chemist to senior chemist, ceramics and minerals research department, Armour Research Foundation, Illinois Institute of Technology. Be-

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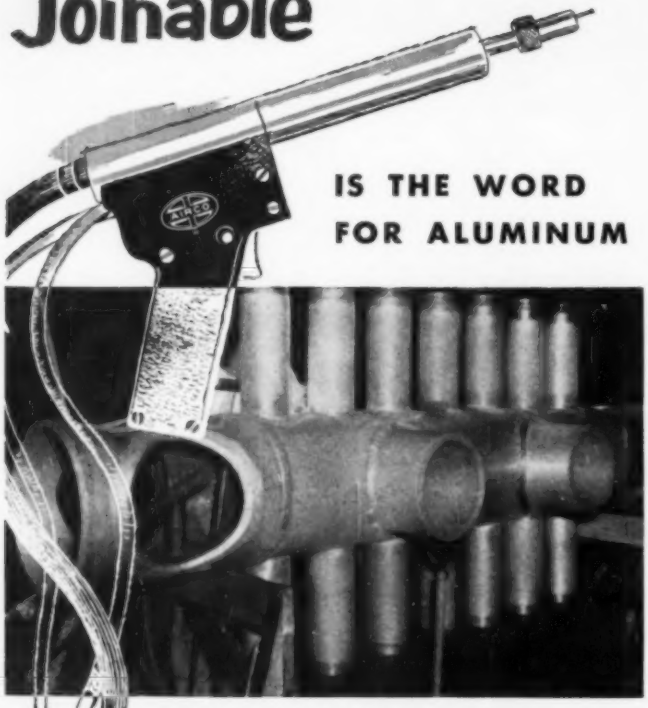

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fore coming to the foundation in 1949, assistant professor at the University of Pittsburgh. Doctorate in chemistry from Ohio State.

Horace S. Isbell. Recipient of the Hillebrand Award of the ACS Washington section. Head of carbohydrate research in the National Bureau of Standards. With the bureau since 1927.

Gilman S. Hooper. Manager of high polymer research for Industrial Rayon Corp. Joined the staff in 1949; has been assistant manager of high polymer research for the past year. Doctorate in chemistry from Brown University.

G. S. Hooper

O. D. Cole

Otis D. Cole. New member of the administrative staff of the research division of Firestone Tire & Rubber Co. Has been assistant director of the chemical and physical research laboratories. With the company in research work since 1931. Studied at Nebraska Wesleyan and Iowa State.

Sidney Katz. Research physical chemist, Armour Research Foundation, Illinois Institute of Technology. Formerly, supervisor of physical chemistry for the Institute of Gas Technology. From 1941-45, conducted research for Goldsmith Bros. Smelting and Refining Co. Doctorate from McGill.

Erwin G. Somogyi. Director of research, Monsanto's Merrimac Division. Formerly, associate research director of the company's plastics division. Company history: assigned to the control laboratory of the organic chemicals division in St. Louis, 1935; group leader in the research department there, 1937; transferred to Springfield as assistant research director, 1948; associate director, 1950. Chemical engineering graduate of Michigan University.

Norman A. Shepard. Chairman of a committee on materials, Department of Defense Research and

Development Board. Since 1941, director of chemical research, American Cyanamid. Joined the staff in 1936 as director, technical service. Previously, director of organic chemical research and director of chemical research, Firestone Tire and Rubber Co. During World War II, consultant to the Baruch-Conant-Compton Rubber Survey Committee, Rubber Reserve Co., WPB, Office of Scientific Research and Development. Member of the Research and Development Board Committee on Equipment and Materials since its inception.

Howard O. McMahon. Science director, Arthur D. Little, Inc. With the firm since 1944. Winner in 1951 of the Edward Longstreth Medal of the Franklin Institute. Doctorate from MIT.

Gordon M. Kline. Recipient of the first annual Honor Award of the Washington chapter of the American Institute of Chemists. Chief of the organic and fibrous materials division of the National Bureau of Standards. Technical editor of *Modern Plastics*; editorial director of "Modern Plastics Encyclopedia."

Raymond J. Lawn. Supervisor of synthetic coatings research, Pittsburgh Coke & Chemical Co. Previous employers: Plaskon Division, Johns-Manville and, most recently, United Wallpaper Corp. Chemical engineering graduate of Worcester Polytech.

R. J. Lawn

I. B. Remsen

Irving B. Remsen, Jr. Member of the headquarters engineering staff of Hall Laboratories. Formerly a division engineer of American Viscose Corp. Before that, assistant supervisor with Atlas Powder Co. Lehigh graduate.

Billie O. Blackburn. Now associated with the technical service laboratory of Shell Chemical, Union, N. J. Former research chemist at Shell Development, Emeryville, Calif. New director of microanalysis for Shell Development at Emeryville: **A. B. Bullock.** New research supervisors at Emeryville: **G. W. Bond,**

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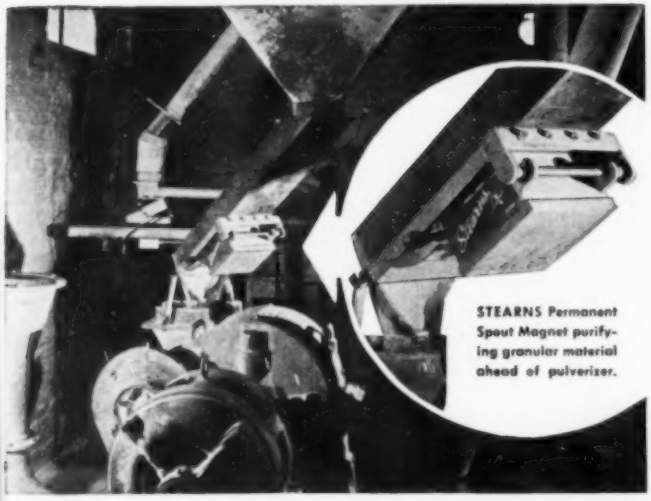

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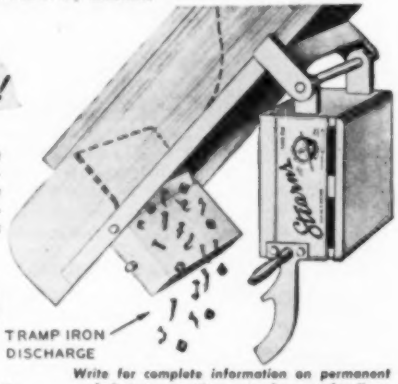

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W. E. Lobo

R. L. Pigford

Walter E. Lobo, director of the chemical engineering division of M. W. Kellogg Co., and **Robert L. Pigford**, chairman of the department of chemical engineering of the University of Delaware, have been appointed to the editorial advisory committee for the Chemical Engineering Series of McGraw-Hill tests and reference books. This committee, organized in 1925, laid the groundwork for a coordinated literature in chemical engineering. The series is now made up of over thirty texts and handbooks. Some of them have gone through three and four editions and have been translated into foreign languages.

S. D. Kirkpatrick has succeeded H. C. Parmelee, under whom the committee was organized, as chairman and consulting editor for the Chemical Engineering Series.

Delmar H. Larsen. Independent consulting chemist and chemical engineer and patent agent, Los Angeles. For the past 15 years, director of research then manager of the patent department, Baroid Sales Division, National Lead Co.

D. S. Gaarder. From assistant general manager to manager, new products department, general industrial division, Sherwin-Williams. **L. M. Muse:** from assistant to the general manager to manager of the division's branches department.

Leonard Shapiro. Manager, textile division, American Polymer Corp., Peabody, Mass. Former positions: successively research director for Interlaken Mills, Warwick Chemical, Alrose Chemical, Sythron, Inc. Studied at MIT.

Robert O. Sauer. Manager, engineering section, GE's chemical division. Started in the company as a research associate in the Schenectady, N. Y., laboratory, then section engineer in the silicone products plant. Doctorate from the University of Illinois. New manager of the manufacturing section; **James R. Don-**

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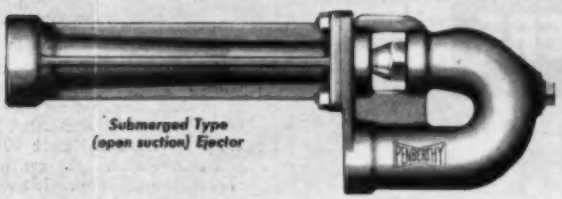

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PENBERTHY AUTOMATIC INJECTOR—Will supply feed water to boiler at minimum cost. Quickly, easily installed, reliable under most severe operating conditions. Ask for Bulletin 513.

4731

PENBERTHY INJECTOR COMPANY

DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

Detroit 2, Michigan

•

Established 1886

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Canadian Plant—Windsor, Ontario

MICRO METALLIC

HEADQUARTERS

FOR YOUR

FILTRATION

PROBLEMS

*This lists only a few applications

MICRO METALLIC CORPORATION

31 Sea Cliff Avenue, Glen Cove, N. Y.

nalley, formerly facilities engineer for the silicone manufacturing division. Came to GE in 1943 as a research associate in the Schenectady research laboratory. Made manager of the Waterford plant in 1948. Doctorate in chemical engineering from Cornell. New manager of the division's marketing section: **Mark K. Howlett,** formerly field sales supervisor for silicones. Started with GE in the insulation section of the Schenectady Works Laboratory. Previously with Tennessee Eastman at Oak Ridge. Purdue graduate.

Johan Bjorksten. Head of research, Ray-O-Vac Co. Since 1944, head of his own company, Bjorksten Research Laboratories. Prior to that, chemical director of Quaker Chemical Products, chief chemist for Ditto, Inc., in charge of development for the Pepsodent Co.

J. Bjorksten

C. L. Smith

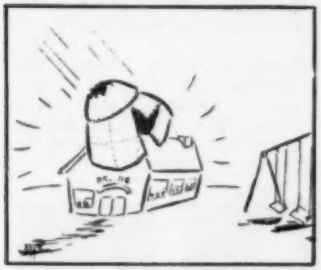
Charles L. Smith. Associate director of product development in charge of agricultural chemicals, Ethyl Corp. With Ethyl since 1949 in technical work in the agricultural chemicals field. Formerly technical advisor to the National Agricultural Chemical Assn. Doctorate from Rutgers.

James W. Hutchison. General manager for Reynolds Metals' new $30 million aluminum reduction plant to be built near Arkadelphia, Ark. Currently, superintendent of the company's Jones Mill plant. **Ralph S. Sherwin, Jr.:** construction manager and general manager of the company's alumina plant to be built in Corpus Christi. Formerly at the Listerhill, Ala., plant.

Hamilton F. Croft. President of S. C. Johnson & Son, Ltd., Brantford, Ont. With the company for 31 years, most recently as managing director. New chairman of the board, **H. F. Johnson,** formerly president.

Maurice F. Murphy. With the staff of chemical engineers at Atlantic

LITTLE BONER



Atomic Blowout

Everybody knew that the oil pump on that 2,000-cfm. air compressor had to be flushed of residual oil once a month. They also knew that the oil ducts had to be blown out with air before the reservoir was filled.

Yet one morning the air receiver—a 20,000 cu. ft. riveted affair located just outside the power house—blew up. And how!

The body of the tank went clear over the engine room and landed in the school yard next door. One 6-ft. diameter end section sailed for 1,000 ft. and thudded into a farmer's pasture.

After things had settled down a bit the engineers began to figure out what had happened. Yes, the operator had flushed out the pump, all right, and blown down the lines to the bearings. Yes, and he had filled the pump's tank.

But—and this was his big mistake—he had filled the tank with furniture polish instead of with oil!

The volatile polish had carbonized and incandescent particles had moved to the receiver. That was when the explosive mixture of oxygen and oil vapor let go

An atomic energy plant is just about the safest place you can ever work at, but little boners happen there, too. If you've lived through a true "little boner," why not tell us about it? Send it to the Editor, **Chemical Engineering**, 330 West 42nd St., New York 36, N. Y.

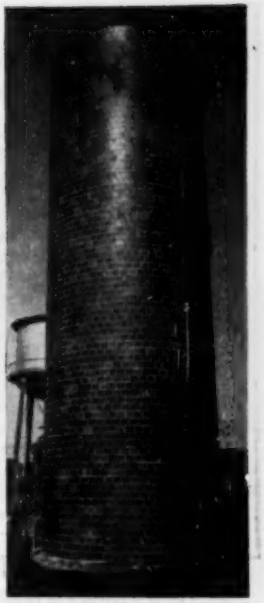
Research Corp., Alexandria, Va. Formerly with the combustion subcommittee of the National Advisory Committee for Aeronautics. Marquette graduate.

Chester U. Stevens. New member of the research staff, Crown Chemical Corp. Since 1947 he has been in the research and development division of Lonsdale Co. Before that, National Aniline, Carter's Ink Co. Harvard graduate.

Henry Raich. Director of special projects, research and development laboratories, Nuodex Products Co., Elizabeth, N. J. Has done research work for Mellon Institute and the

GOT BULK STORAGE PROBLEMS?
...solve them with

Kalamazoo
GLAZED TILE INDUSTRIAL STORAGE BINS



Coal . . . cement . . . clay . . . plaster . . . fertilizer . . . whatever the material, Kalamazoo glazed tile hollow-wall construction protects it from condensation, freezing and corrosion . . . keeps it always clean and dry . . . eliminates waste, shrinkage, spoilage.

And, the clean-cut neatness of Kalamazoo Glazed Tile Storage Bins complements the appearance of modern industrial buildings . . . an added Kalamazoo advantage.

Write today for complete information.

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424 HARRISON ST., KALAMAZOO, MICHIGAN
Kalamazoo TANK and SILO CO.

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Suppliers to GOVERNMENT and INDUSTRY for 75 Years...
to the ARMED FORCES through three wars!

Bendix Friez is part of a great industrial organization whose peace-time potential is being maintained while engaged in vital work for national defense. We are doing our utmost to deliver non-military items such as meteorological instruments, electronic devices, thermistors and a variety of other equipment consistent with our other high priority business.

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CRUSHERS
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For experimental laboratories, pilot plants and exacting small scale operations, rugged American Laboratory Crushers provide controlled, *uniform* reduction of fibrous and friable materals—soft or hard.

Custom-built with rolling ring or hammer type rotors, they handle specialzed reduction jobs with maximum efficiency—at lower cost.

• For reduction of chemicals, by-products, coal, clays, glass, food, mineral and many other products in wide variety.

American PULVERIZER COMPANY

Send for your copy of "BETTER TESTING AND SMALL SCALE REDUCTION".

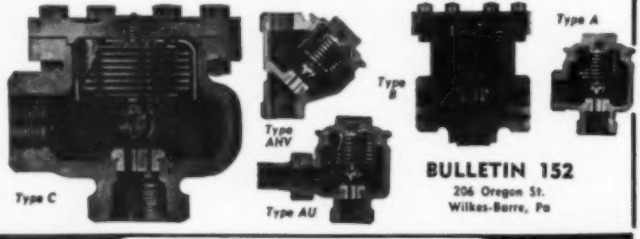
Originators and Manufacturers of Ring Crushers and Pulverizers

1219 Macklind Ave.
St. Louis 10, Mo.

Nicholson Traps Help

CUT STEAM COST $500,000 A YEAR

At one of the nation's large processing plants a campaign to promote economical steam use by improving heat transfer efficiency has resulted in a yearly saving of $500,000. Credit for a fair portion of this is given to improved steam trapping, which resulted from the installation of Nicholson thermostatic traps. To see why an increasing number of leading plants are standardizing on Nicholsons for positive drainage and faster heat transfer, send for Bulletin 152.



BULLETIN 152
206 Oregon St.
Wilkes-Barre, Pa

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

NAMES IN THE NEWS, cont. . .

Los Alamos Scientific Laboratory. Doctorate from Rensselaer.

Kenneth D. Nichols. Army service member of the Dept. of Defense Research and Development Board. General Nichols is deputy director of guided with in the office of the Secretary of Defense.

C. A. Hampel

R. Scott Modjeska

Clifford A. Hampel and R. Scott Modjeska. Founders of the new Hampel-Modjeska Laboratories. To specialize in the fields of industrial chemicals, electrochemical and electrometallurgical processes and products, and recovery and utilization of strategic metals. Mr. Hampel's former employers: Mathieson Chemical Corp., Diamond Alkali, Manhattan Project, Minnesota Mining and Mfg. Co., Cardox Corp., Armour Research Foundation. Graduate of the University of Minnesota. Mr. Modjeska remains a director of Scientific Control Laboratories, Chicago. Former employers: B. Mercil & Sons Plating Co., Apollo Metal Works, Nickel-Chromium Corp. Studied at Crane College, DePaul and the University of Chicago.

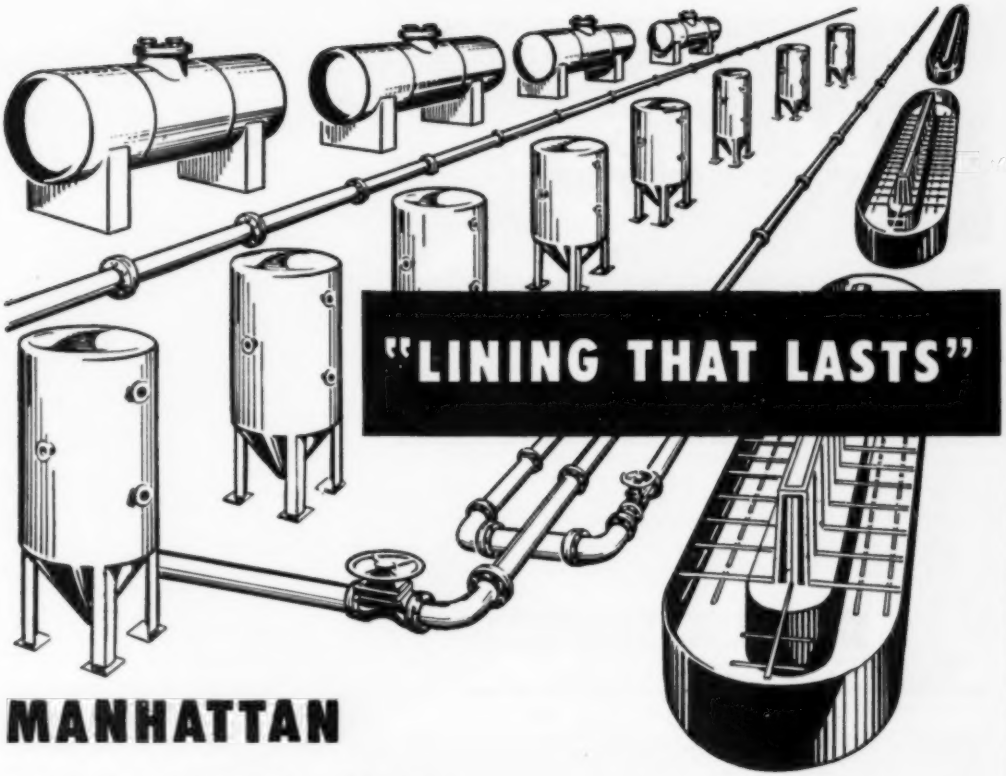
H. Doyle. From senior research engineer to supervisor of smoke treatment and ventilation, Consolidated Mining & Smelting Co. of Canada. With the company since 1922. Chemical engineering graduate of the University of B.C.

Richard C. Ruffin. From production superintendent of the Woodbridge, N. J., plant to manager of the Valdosta, Ga., rosin and gum plant, American Cyanamid. He succeeds **Thomas Pacey, Jr.**, who will manage the plant at Georgetown, S. C.

OBITUARIES

M. W. Kellogg, 79, founder and chairman of the board of M. W. Kellogg Co., died in New York, February 22.

William S. Calcott, 58, manager, development section, technical division of Du Pont's organic chemicals



MANHATTAN

RUBBER LINING

How can you be sure your costly steel equipment for processing is permanently protected from corrosion? Manhattan rubber lining engineers have the answer . . . They have developed a method of bonding rubber to metal so securely that tests prove it can't be pulled off • Manhattan Rubber Lining also expands and contracts with metal under temperature changes without hardening or cracking. It withstands the normal knocks of usage. This means protection from contamination in chemical processing . . . and in metal plating it means elimination of stray currents that might otherwise be dangerous. The resistance of Manhattan rubber lining to most acids, caustics and alkalies is practically ageless.

CALL MANHATTAN FOR "LINING THAT LASTS"

RUBBER LINING PLANTS AT PASSAIC, N. J. AND NORTH CHARLESTON, S. C.

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Packings • Brake Linings • Brake Blocks
Clutch Facings • Asbestos Textiles • Sintered Metal Parts • Bowling Balls

HAVE ENTRAINMENT PROBLEMS?

HAS the ANSWER . . .

Pictured above is a Peerless 5000# W.P. Separator. It is removing condensate and lubricating oil from the reaction gas to prevent contamination of the catalyst, for production of ammonia.

Consult Peerless for help in solving your entrainment problems.

PEERLESS MFG. CO.

PEERLESS MANUFACTURING CO.

P. O. BOX 7193 • DALLAS, TEXAS • Dixon 8431

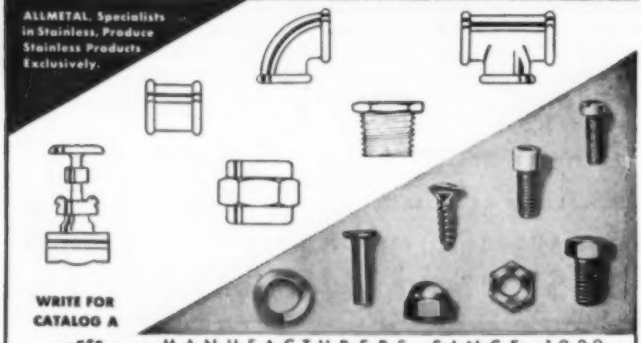
REPRESENTATIVES IN ALL PRINCIPAL CITIES

FOR YOUR STAINLESS STEEL FITTINGS AND FASTENERS

IT'S ALLMETAL FOR QUALITY AND DELIVERY

Allmetal's fasteners and fittings are stocked in types 304 and 316. Specials to order. All made right by Allmetal.

ALLMETAL, Specialists in Stainless, Produce Stainless Products Exclusively.



WRITE FOR CATALOG A

STAINLESS STEEL FASTENERS

MANUFACTURERS SINCE 1929

ALLMETAL

SCREW PRODUCTS COMPANY, INC.

33 GREENE STREET NEW YORK 13, N. Y.

department, died February 15. He had been with Du Pont since 1915.

Fred F. Fitzgerald, 69, director of research for American Can Co. from 1935 until his retirement in 1942, died at Joliet, Ill., February 7.

GERMANIUM

Continued from page 160

tilled from the copper and hydrolyzed in ice water to obtain pure germanium dioxide, which is washed completely free from chloride and is then ready for reduction to the metal. Oddly enough, if warm water is used, the dioxide is formed as an insoluble modification that is highly refractory and very difficult to reduce to the metal in hydrogen furnaces.

It is the pure white powder, germanium dioxide, that Eagle-Picher usually ships to electronics manufacturers, who reduce it to the metal at their plants.

REDUCING DIOXIDE

Germanium dioxide is reduced by heating in hydrogen. The dioxide is packed into graphite boats and heated in an electric furnace in a current of hydrogen at 600-650 deg. C. until no more water is evolved. The hydrogen is then replaced by nitrogen and the temperature raised to 1,000 deg. C. to melt the resulting powder into ingot form. During the reduction the temperature must be kept below 700 deg. C. to avoid loss of volatile germanium monoxide formed in the first stage of reduction. Nitrogen or an inert gas must be used for the final melting to eliminate hydrogen from the metal. If germanium is melted in hydrogen, the ingot will be porous since molten germanium absorbs hydrogen, which is liberated when the metal solidifies, producing tiny blowholes.

Eagle-Picher does produce the metal, although most users prefer to make it themselves by their own methods. At Eagle-Picher, the germanium dioxide is changed to metal by heating it at 1,100 deg. F. in an atmosphere of hydrogen. The germanium dioxide is slowly reduced to black, powdery germanium metal. Next, this powder is melted at a higher temperature into a slug. It is then slowly cooled to room temperature and removed from the furnace, ready for its job in industry. It has been two months in process from the time the ore left the mine until the silvery metal is removed from the furnace.

CHECK THESE 3 WAYS YOU CAN SAVE WITH THIS MULTI-PURPOSE INSTRUMENT

Here is the most sensible idea you've ever seen in a recorder or controller—an instrument you can change as your instrument needs change, that you can add to, subtract from, or whose functions you can increase or decrease at little or no expense.

✓ **Save money when you add new functions by adding only those new assemblies needed.**

✓ **Save time-delays by making changes on the job site without returning to factory.**

✓ **Save money on inventory. Parts are interchangeable, fit all Gotham Convertible recorders. You can service a whole group with a minimum stock of basic elements.**

What you can do with the Gotham Convertible

Depending on the chart size of the recorder (6", 9" or 12") you can have a 1-2-3 or 4 pen recorder with 14 pressure, temperature and time operation combinations or a recorder-controller with 38 possible pressure, temperature, and time combinations.

SELF-CONTAINED PORTABLE RECORDER

A portable recorder which has a carrying handle, legs and retaining holder for capillary and bulb. Built from Gotham standard elements, interchangeable with other Gotham instruments. 6", 9" and 12" chart sizes. Mercury, Vapor or Pressure Activated. Spring or electric chart drive. See Catalog 400.

RECORDING PSYCHROMETER

Incorporates the same highly accurate and responsive thermal systems and contains all other Gotham standard convertible features. Wet and dry bulb type. Motor-driven suction fan. 12" chart size. Catalog 400.

RECORDING HYGROMETER

A 2-pen recorder of the wet and dry bulb type. Mercury or Vapor Actuated. 9" and 12" chart sizes. Available with variety of wet and dry bulb assemblies depending on application. Catalog 400.

GOTHAM INSTRUMENTS

Keep everything under control with Gotham

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Division of American Machine and Metals, Inc.
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Please send me a copy of your

- ☐ Catalog 100—Industrial Thermometers
- ☐ Catalog 200—Dial Type Thermometers
- ☐ Catalog 400—Recorders, Psychrometers, Hygrometers
- ☐ Catalog 500—Controllers
- ☐ Have your representative call. No obligation.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

INDUSTRIAL NOTES

NEW FACILITIES

Pittsburgh Coke & Chemical Co.—Tank farm of a new plasticizer plant at Neville Island which will be in operation by June. In a unique operation, phthalic anhydride plant in the background above will supply molten phthalic directly to the plasticizer plant.

Reheis Co., Berkeley Heights, N. J.—A new organic chemical division to produce vegetable enzymes tyrosinase, asorbic acid oxidase and invertase.

John Hewson Co., New York—A Philadelphia office to handle field application work, service and sale for its high voltage insulation testers.

Vick Chemical Co., New York—A $500,000 drug manufacturing plant in Manila, Philippines, for its subsidiary, Vick International, Inc.

Industrial Oven, Inc., Cleveland—A web coating research and development laboratory to carry on an extensive program of research and investigation of production methods in the coating field.

Stanford Research Institute, Stanford, Calif. — A radiation engineering laboratory to make available for research in industrial uses of atomic and nuclear science the largest source of radioactivity outside of AEC installations.

Minnesota Mining & Mfg. Co., St. Paul—A Boston branch sales office and warehouse.

Monsanto Chemical Co.—A one-third increase in its plastics division research facilities at Springfield, Mass. Thirty additional scientists and technologists have been employed to cope with the division's intensified research activities.

Mathieson Chemical Corp., Baltimore—A large dry mixing plant for both fertilizer and insecticides through the purchase of the fertilizer division of Tovrea Land and Cattle Co. at Phoenix, Ariz.

Pittsburgh Plate Glass Co.'s paint division—A preform molding laboratory at its Milwaukee Research Labratory.

C. H. Wheeler Mfg. Co.—A $6,000,000 addition to its Philadelphia plant to increase condenser and pump production.

Sterling Electric Motors, Inc., Los Angeles—A new district office in Denver headed by James R. Hughes.

E. I. du Pont de Nemours & Co.—A $2 million laboratory of industrial toxicology near Newark, Del., to be completed in about a year.

Bird Machine Co., South Walpole, Mass.—A West Coast office to be headed by Blanchard D. Warren.

Tube-Kote, Inc.—A $40,000 office building on the grounds of its plant in Houston.

Bakelite Co. (Canada), Ltd.—A plant at Belleville, Ont., for the production of formaldehyde.

Reichhold Chemicals, Inc.—Manufacturing facilities in Israel for a complete line of synthetic resins.

Garfield Chemical and Mfg. Co.—A $2.5 million addition to present sulphuric acid production facilities at Garfield, Utah. It will boost output to 250 tons a day.

Diamond Alkali Co.—Expanded facilities for chlorine production at its Painesville, Ohio, plant. Construction has already started.

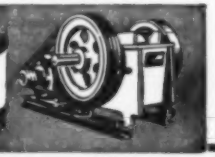
NEW LINES

Dexter Chemical Corp., New York—Detergents, wetting agents, finishes for the textile industry through the acquisition of Lake Chemical Corp.

National Waterproof Papers, Inc., Camden, N. J.—Crinkled kraft

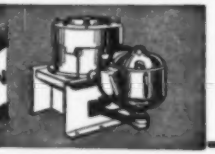
MASSCO Laboratory Crushers & Pulverizers

LABORATORY JAW CRUSHER



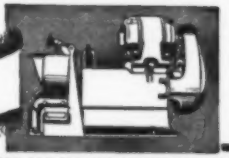
Double acting jaw delivers two blows per revolution, speeds crushing. Forward and downward motion increases capacity over conventional stroke, particularly on moist materials. Hand wheel replaces usual wrench or shims for jaw opening adjustment. Discharge openings ¼" to 1½" available. Easy to use, compact and relatively light weight welded steel construction.

GY-ROLL REDUCTION CRUSHER



Reduces ½" feed to as fine as 10 Mesh in a single pass. Very high capacity and low power consumption; replaces bulky, unhandy equipment such as rolls and coffee mill. Two sizes available, 6" and 10".

LABORATORY PULVERIZER



The Massco-McCool is a disc-type grinder designed for pulverizing to fine meshes in one operation. Planetary movement ensures long grinding surface life. No gears—reduces power; 100% anti-friction grease lubricated bearings; grinds more samples per hour at lower cost.

WRITE FOR SPECIFICATIONS AND PRICES

THE Mine & Smelter SUPPLY COMPANY

1462 17th St. Denver 2, Colo.—Offices in Salt Lake City, El Paso, 17th Broadway, N.Y.C.

Slurry in a Hurry gets a helping hand

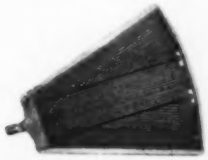
and Everdur Alloys are selected for use in The American Continuous Filter that handles it

6-disc continuous filter made by Oliver United Filters Inc.

American Continuous Disc Type Filters, made by Oliver United Filters Inc., are designed for uninterrupted operation and thus help industries speed processing, increase capacity, and cut operating costs.

In these filters, sectored discs, under vacuum, revolve through tank slurry. Filtrate passes to outlet pipes parallel to the shaft. The emerging cake of solids is first washed, then dewatered, and finally, after release of vacuum, is discharged automatically. Continuing on their revolution, the clean discs re-enter the slurry to form a new cake. Action is always continuous.

Important to economical operation is the ability of such equipment to endure strain, wear, and corrosion. Everdur* (ANACONDA Copper-Silicon Alloys), chosen for such vital parts as tank, shaft parts, valves, wear plates, wash nozzles, disc sector trim, etc., has this ability. Readily workable and weldable—and easily fabricated by all conventional methods — corrosion-resistant Everdur is produced in most all commercial shapes, including casting ingots.



Wood disc sector made of redwood fastened with Everdur.

Shaft, showing drainage pipes which lead to ported valve. Pipes and shaft-protecting shield are made of Everdur.

Your own equipment or corrosion problem will be given careful attention by our Technical Department. They will gladly help you select the most suitable Everdur Alloy. Write The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

Everdur—*strong—weldable—workable—corrosion-resistant*

ANACONDA® *Reg. U. S. Pat. Off.

COPPER-SILICON ALLOYS

NOW...

STANDARDIZED AND STOCKED FOR PROMPT DELIVERY

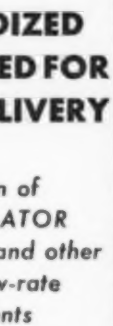
Selection of FLOWRATOR Meters and other F&P flow-rate instruments simplified

Standardization of F&P indicating instruments permits quantity manufacture, lower costs, and quicker deliveries.

You can now select flow meters from catalog data to meet your immediate requirements. Engineering charges and manufacturing delays are eliminated.

WRITE FOR NEW "STOCK FLOW METER" BULLETIN

Contains complete data, sizes, and prices with illustrations of F&P instruments now stocked. It lists all F&P sales engineering offices showing which offices carry stock meters.

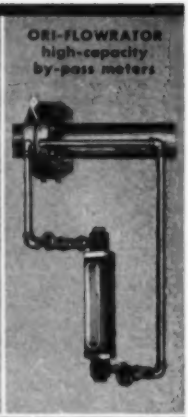


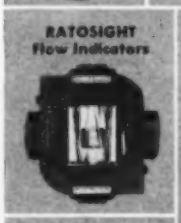
FISCHER & PORTER CO.

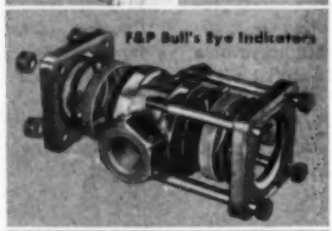
DEPT. 2P-9B

HATBORO, PENNSYLVANIA, U. S. A.

PROCESS CONTROL INSTRUMENTS







INDUSTRIAL NOTES, cont. . .

multi-wall bags for bulk shipment of pharmaceuticals, numerous chemicals, farm products, mineral concentrates, fertilizers and other crystalline and granulated products. Product name is Tufpak.

Special Screw Products Co., Bedford, Ohio—Corrosion resistant stainless steel fittings for Schedule 5 S and 10 S tubing. Included is a standard selection of elbows, tees, unions and connectors for tubing sizes up to and including 1 in.

Hewitt-Robins Inc., New York—Wire fabric screen cloth through the acquisition of the Korb-Pettit Co., Philadelphia. The company has also recently acquired Micro Engineers, conveyor machinery manufacturers in Johannesburg, South Africa.

NEW COMPANIES

Vacuum Metals Corp., Cambridge, Mass., to produce vacuum cast gas free metals and alloys. It is a wholly-owned subsidiary of National Research Corp.

Chemical Coatings and Engineering Co., Chester, Pa., to engage in the sales and engineering of a complete line of Neoprene based corrosion control coatings.

NEW REPRESENTATIVES

Vapor Recovery Systems Co., Compton, Calif., has appointed Arduser & Co., Tulsa, Okla., as sales agents in Oklahoma, northeastern Texas, Kansas and Nebraska. They've appointed Paul B. Mueller Co., Minneapolis, representative for its tank equipment, gas control and safety devices in the Dakotas, Minnesota and western Wisconsin.

Swartwout Co. has appointed Mercator de Mexico, S. A., as sales engineering representatives for Mexico.

Fine Organics, Inc. has appointed Canadian Hanson & Van Winkle Co., Toronto, as Canadian sales representatives for its aviation-industrial chemicals division.

Morehouse Industries, Los Angeles, manufacturer of milling equipment, has appointed Pacific Coast Chemicals Co., San Francisco, its exclusive northern California agent.

Diamond Alkali Co., Cleveland, has appointed Apex Co., Memphis, Tenn, a distributor of its complete

line of specialized laundry detergents, sours and blues.

Hammel-Dahl Co., Providence, has appointed Cowles & Co., Dallas, its sales and service representative in the central Texas area. The company makes automatic control equipment.

Cleaver-Brooks Co., Milwaukee, has appointed E. C. Giberson, Des Moines, Iowa, as manufacturer's representative for its boiler equipment.

VioBin Corp., Monticello, Ill., has designated H. L. Barnebey, Pittsburgh, Pa., as licensing agent for its azeotropic solvent extraction process. By this process, fat and water are simultaneously removed from organic substances.

Cleveland Crane & Engineering Co., Wickliffe, Ohio has appointed W. A. York Co., Philadelphia to represent its Cleveland Tramrail Division in the Philadelphia area. The company makes overhead materials handling equipment.

Ohio-Apex, Inc., division of Food Machinery and Chemical Corp., has appointed Canada Colors and Chemicals Ltd., 1090 King St. West, Toronto, as sales representatives in eastern Canada for its plasticizer and chemical products.

NEW LOCATIONS

American Electroplaters' Society has moved its executive offices to 445 Broad St., Newark, N. J.

Claude B. Schneible Co., manufacturer of dust control systems, has moved to new executive offices at 212 Stephenson Bldg., Detroit.

Midwest Piping & Supply Co. has moved its eastern division offices to 50 Church St., New York.

Wellman Bronze & Aluminum Co. has moved its executive, sales, accounting and purchasing departments to 12800 Shaker Blvd., Cleveland.

Patterson, Moos & Co. has moved its offices and laboratories to 90-28 Van Wyck Expressway, Jamaica, N. Y.

Austin Co. has moved its special devices division to larger quarters at 76 Ninth Ave., New York, because of expanded activity in the development, design and production of electronic computers, control systems and special devices. —*End*

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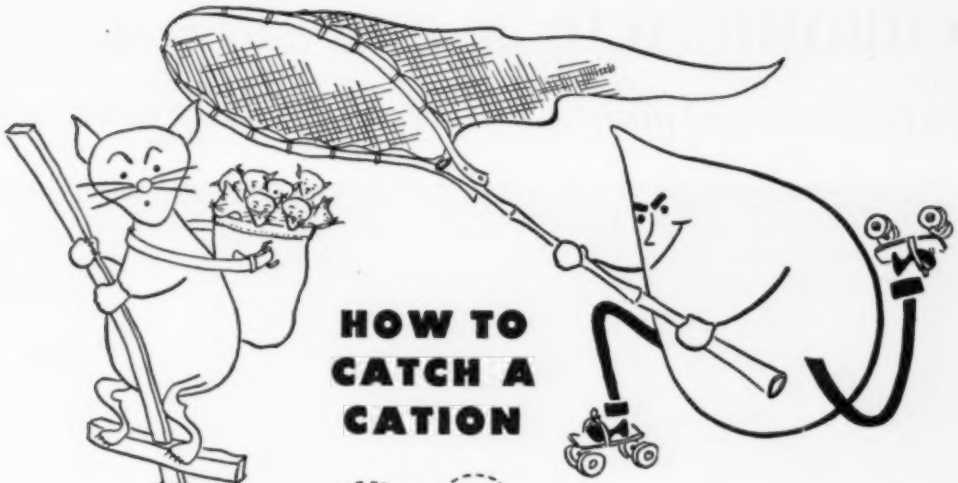

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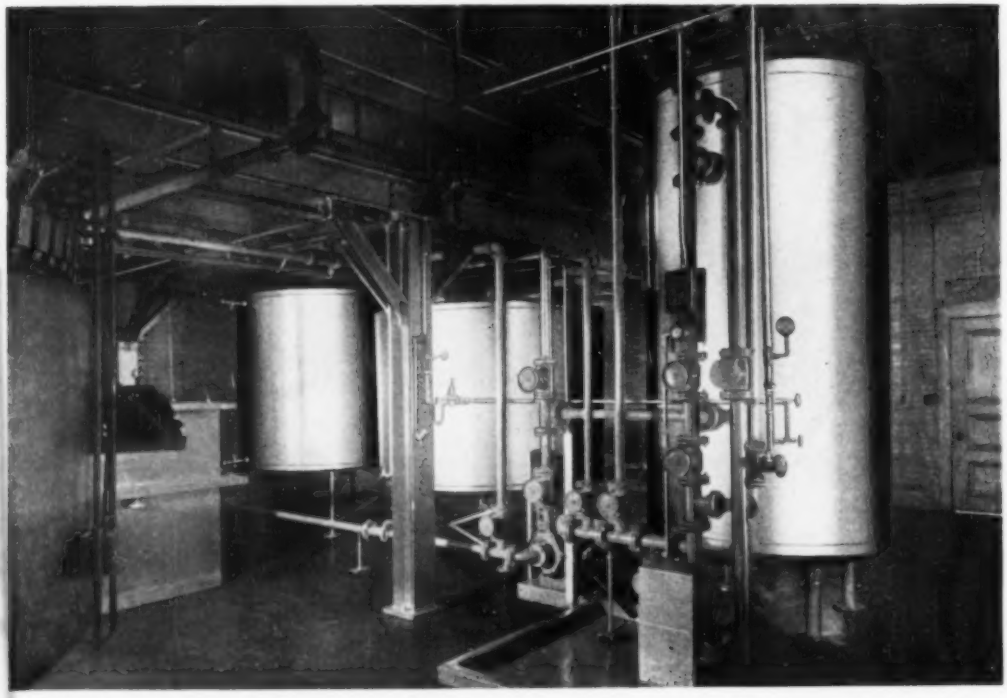
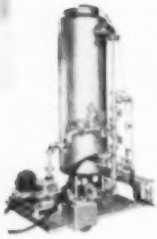


ILLCO-WAY Chrome Purifier in U. S. Government plant employs ionXchange to reclaim critical chrome used in anodizing and hard-chrome plating



Newest ILLCO-WAY development in ionXchange is seen above — a specially engineered Chrome Purifier installation to purify and reclaim chromic acid used in anodizing and hard-chrome plating in a U. S. Government plant. (At the left, a portable version of the same equipment — for use in plants where anodizing tanks are widely separated.) ILLCO-WAY's application of ionXchange to the salvaging of *critical chrome* is typical of the scope and importance of this process to American industry. Other examples: ILLCO-WAY engineered the first successful installation for *beet juice* purification by ionXchange . . . and more recently has developed a similar process for the purification of *crude glycerol*...We will welcome inquiries about liquid purification problems which may involve ionXchange.

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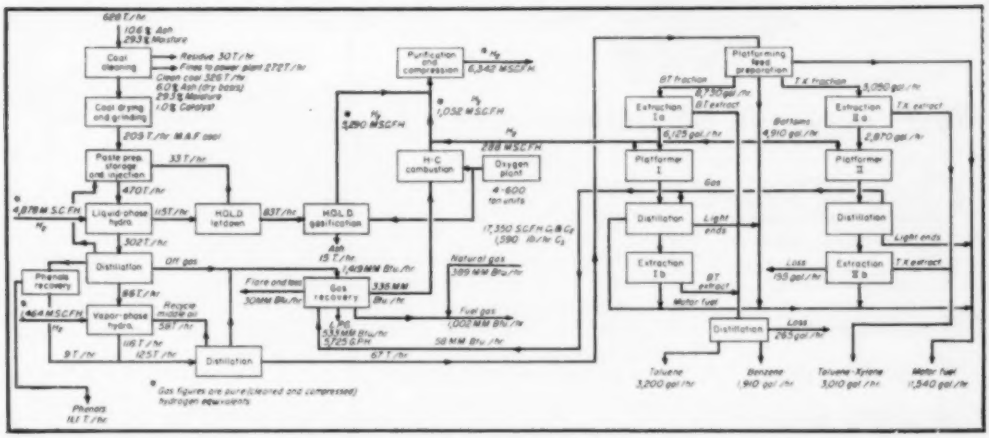

Proposed hydrogenation plant of the Bureau of Mines. Capacity: 15,000 bbl. per day. Cost: $174.5 million.

1952 Outlook: Gas & Liquids from Coal

As demands soar, the chemical, petroleum and gas industries are thinking of coal conversion. By 1975, most inorganic chemicals may come from a few big coal plants.

By 1975, perhaps even earlier, the bulk of U. S. inorganic chemical production may come from a few big gasification and liquefaction plants. Reasoning for this forcast goes something like this:

1. Demand for most chemicals grows. By 1975 demand for many chemicals may be as high as six times present day production.

2. Petroleum and natural gas are becoming the building block for more and more important chemicals. By 1962, a recent estimate shows, 50 percent of the chemicals produced in the U. S. will be petrochemicals.

3. Petroleum and natural gas reserves show no sign of increasing; in fact reserves could dry up quickly within the next 15 years.

Therefore, since any chemical processed from petroleum and natural gas can also be made from coal, the bulk of inorganic chemicals produced in 15 to 25 years are likely to be carbochemicals. They are likely to be turned out in large gasification and liquefaction plants since present investigations indicate best economics in big plants.

Another line of reasoning, probably more fundamental, sees chemical production riding the coat tails of liquid fuel production.

Highlights

1. A detailed cost estimation of a 250-million-cubic-feet-a-day pipeline gas plant: See Gasification—Proposed Plant.

2. A description of the Bureau of Mines coal hydrogenation process. See: Liquefaction—How the Process Works.

3. Various improvements in coal hydrogenation processing made by the Bureau of Mines. See Liquefaction—Process Improvements.

4. Estimated production of chemical and liquid fuels from a future hydrogenation plant. See Liquefaction—Output Debate.

5. Estimate of future demands for chemicals made from Fischer-Tropsch type of processes. See Liquefaction—Fischer-Tropsch.

6. Description of the new Texaco process, an improvement on Fischer-Tropsch. See Liquefaction—Texaco Process.

1. Liquid fuel demands are rising fast. The rapid pace should continue for many years, and could be accelerated by military needs.

2. To meet future needs, industry and the government will have to turn to coal hydrogenation.

3. Future liquid fuel plants will turn out huge quantities of chemical byproducts.

In February, the American Institute of Mining and Metallurgical Engineers held their 173rd general meeting. Here at New York's Statler Hotel, specialists from the Bureau of Mines, the chemical, petroleum and gas industries dealt out ideas and information to each other during a two day symposium on gasification and liquefaction of coal.

In a parade of papers they made several emphatic conclusions:

- Time of plant construction will depend upon economic factors, military needs for liquid fuel and how far the government goes into the liquid fuel field.
- Demand for highly convenient liquid and gaseous fuels is growing in geometric progression.
- Demonstration plant experience proves the hydrogenation process is reliable and operable.
- An initial plant producing large quantities of chemicals in a favorable site using improved processes may be feasible. If erection of such a plant

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QED, *cont.* . .

started now, operation could not begin in less than three years.

• Huge resources of low-rank coals and lignites, which can be cheaply exploited by standard techniques, are available for direct gasification.

Gasification

In areas up north, demand for additional natural gas is high. "Hardly an area, from one end of the country to the other, is adequately supplied," said C. R. Breck[1] of Southern Natural Gas Co.

The Detroit and Pittsburgh areas in 1950 had an excess of 8 million domestic and commercial gas customers. At 330 cu. ft. per customer, average total demand per day would be 2,600 million cubic feet. On the basis of stated maximum pipeline capacity, this is a deficiency of 1,400 cu. ft. per day.

Even if mammoth new natural gas fields are discovered and new pipelines are built into established market areas, deficiencies will probably never be wholly met by natural gas. Without a doubt, manufactured gas, utility men feel, will stage a comeback of such huge proportions as to dwarf its previous history.

Supplemental gas for pipelines will no doubt come from two sources: (1) Coal hydrogenation plants for chemicals and liquid fuels that will turn out a tail gas high in methane as a byproduct; and (2) large scale gasification plants that will produce high Btu. gas as a major product, possibly with chemicals and liquid fuels as byproducts.

The first large scale gasification plants will be located in coal fields on or near long distance transmission lines, according to Julian E. Tobey[2] of Appalachian Coals, Inc. Practically all the major gas transmission lines cross one or more coal fields; such locations will not be hard to find.

To maintain the capacity of the main transmission lines and local city distribution systems, companies will have to produce a gas of 750-1,000 Btu. A much wider range of coals will be adaptable for gas manufacture than those used in the producer and water gas methods for making low Btu. gas.

Proposed Plant: Anticipating coming deficiencies of natural gas, Southern Natural Gas Co. in 1944 initiated a program of investigation on a commercial synthetic gas pipeline. The program, which included experimental and cost estimating work, was set up to answer two questions: (1) is it technically practicable to make pipeline gas from coal; (2) if so, what would it cost? (*Continued*)

FOR LUBRICATING OR HIGHLY VISCOUS LIQUIDS you can't beat the double-helical gear rotary pump. Over thirty years' experience in a wide variety of services has proven this.

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Other advantages of these gear type rotary pumps are: their ability to handle a considerable amount of air or gas in the liquid, and their use with steam jackets for pumping liquids that become solid in normal temperatures. Types GA for general service, GR for heavy-duty service. Type GRJ is steam jacketed. All units can be arranged for motor, turbine, engine, or belt drive with conventional stuffing box or mechanical seal.

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P-2.1

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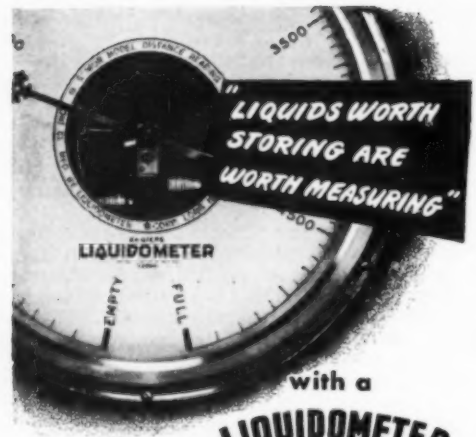

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QED, cont. . .

For its experimental work, the company decided on the German Lurgi process, making synthesis gas from American bituminous coal and using a nickel catalyst for converting the synthesis gas to methane. Under a cooperative arrangement with the Bureau of Mines, the experimental work was carried on in the bureau's Pittsburgh laboratory.

To make the cost estimate realistic, Southern assumed a plant to be set up on the Monongahela River: Pittsburgh seam bituminous coal would be used; the plant output would be about 250 million cubic feet gas per day at 1,200 lb. pressure.

Principal steps in the over-all process would be:

1. A synthesis gas is made from char product of the low-temperature carbonization of coal. The cost estimates assume the use of Lurgi gasifiers and operating data from company experiments.

2. Gas is purified. Cost estimates assume the use of a recently developed German solvent, Rectisol, which dehydrates the gas and removes all forms of sulphur while reducing carbon dioxide content to about 4 percent.

3. Methanization. Cost estimates assume recirculation through the catalytic chamber a number of times, the carbon monoxide and hydrogen in the synthesis gas reacting to form methane.

4. Gas is again purified by Rectisol. Water and carbon dioxide from secondary reactions in the catalyst chamber are removed. The estimate assumes gas make-up after final purification to be:

CO_2	0.8%
N_2	3.8
CH_4	84.2
C_2H_6 & III.	3.7
H_2	7.5
CO	0.0
	100.0

Calorific value is about 925 Btu.

5. Entire operation takes place at 300 psi. In this step the gas is compressed to 1,200 lb. for delivery to the pipeline.

Assuming cost of coal to be $3.70 a ton stock-piled at the plant, the cost of these steps, according to Blaw-Knox, who made the estimate, would be:

	Cost in Cents per MCF (At 100 Percent Load Factor)	
Net cost of coal and char	20.44¢	
Plantsite facilities	5.00	25.44
1. Gasification	17.91	
2. Initial purification	6.44	
3. Methanization	2.54	
4. Final purification	1.25	
5. Final compression	1.19	29.33
Total cost of gas		54.77¢

Over-all cost, starting from the proc-

ess char pile, would be $156 million. Coal reserves for 50 years, mine development, coal transport facilities, etc., $63 million. Thus, total money required would be an estimated $219 million, exclusive of sulphur recovery and low-temperature carbonization plant.

A synthetic pipeline gas plant on the Monongahela River could operate at 90 percent load. Cost of gas at 90 percent would be about 58¢ per MCF. Once a permanent deficiency in normal gas supply comes up, a price of 58¢ in this area would certainly not be prohibitive, according to Southern.

"I believe there is justification for the assumption, at least in a preliminary estimate, that the cost of low-temperature carbonization can be made self-supporting," Breck commented.

Prospectus: The problem then is economic. When the price is right, the gas utilities will build. Meanwhile development work goes on.

Besides the Lurgi process, the Winkler, also a German process, has gained some commercial success. Both processes work best with highly reactive, non-caking coals or char. American lignites and subbituminous are nearest in character to the German brown coals used in the two processes.

However, for American coals, particularly the high-rank caking coals of low reactivity, these processes would require a pretreatment step. To prevent agglutination under the operating pressure and under the lower reactivity, pretreatment is necessary.

Pretreatment, which takes place in a fixed bed under pressure, needs a lot of ironing out. Bureau of Mines has done some pretreatment work independent of gasification. At Battelle Memorial Institute, work is going on toward integrating pretreatment with gasification.

The success of current and future investigations on pretreatment will ultimately govern the choice of method for producing synthesis gas for high-Btu. pipeline gas. The other method, which would burn finely divided coal either in fluidized beds or in entrainment, has been developed primarily for the synthesis of chemicals.

In development work conducted by the Bureau of Mines, oxygen has been used for gasification. Any process using oxygen would require a high capital investment, a big drawback. For small utilities, the use of oxygen would probably not be feasible, according to L. L. Newman*, gas engineer of the Bureau.

However, gasification of coal by means of air is under development in Germany for underfiring coke ovens.

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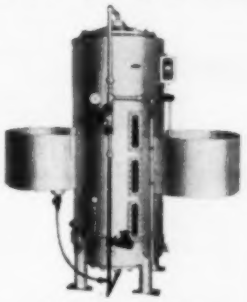

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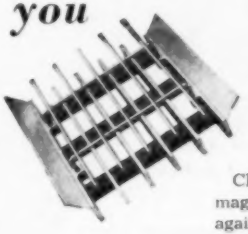

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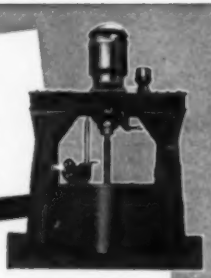

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QED, cont. . .

Proposals have been made here to investigate the early work of Winkler. He combined the advantages of fluidization with the intermittent water-gas process for utilizing caking or other coals without pretreatment.

Bureau of Mines have conducted small scale preliminary tests on these investigations. Results have been encouraging enough to justify the construction of a larger plant. Work on it has already begun.

Liquefaction

Demonstration Plant: Along with its work on synthetic pipeline gas, the Bureau of Mines has carried out heavy development on the gasification and hydrogenation of coal to produce chemicals and liquid fuels.

Its coal hydrogenation demonstration plant at Louisiana, Mo., placed on stream in 1949, has operated continuously since. A short vapor-phase run was made on North Dakota lignite tar distillate oil in 1949. In 1950—four short exploratory liquid-phase runs and one vapor-phase run, all on Rock Springs coal.

Three extended liquid-phase runs and one vapor-phase run were completed in 1951. About 2,500 tons of west Kentucky coal were converted into 350,000 gal. of gasoline with an 83.5 octane rating.

An additional 2,500 tons of Illinois No. 6 coal were converted into vapor-phase charging stock and liquid-phase processing of 4,400 tons of subbituminous coal from Lake De Smet, Wyo., was completed in January 1952.

Since 1949, all units have operated on schedule.

"One of the most surprising things about liquid-phase hydrogenation operation is that in spite of almost daily problems of seemingly serious magnitude at one place or another, it was possible to maintain production at a high level," L. C. Skinner, a chemical engineer at the plant, commented.

"This is particularly impressive proof of the operability of the process when one considers the difficulties inherent in small high-pressure plants where volumes in many streams at flowing conditions are extremely small, added to the fact that each run is on a widely different coal or raw material."

Corrosion has been practically nonexistent. Erosion occurred at points where liquids are depressured from 10,000 psi. to 100 psi.—particularly in those liquid streams containing ash, catalyst and unconverted coal.

Economics: Processes used by the plant were mostly conventional with stress put on high thermal efficiency. Byproducts, except phenols, were not

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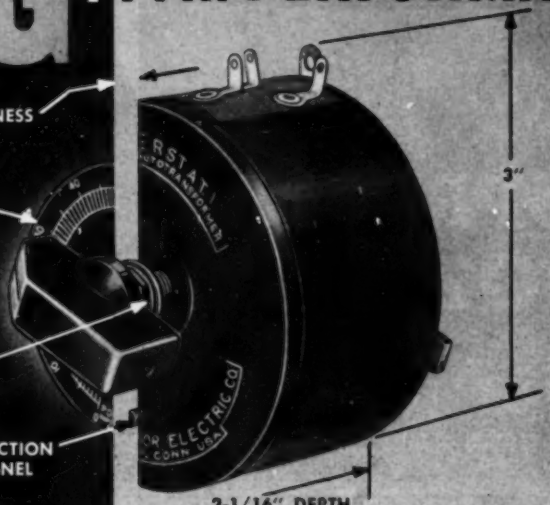

TYPE 10 POWERSTAT
VARIABLE TRANSFORMER

RATED:

INPUT: 120 Volts, 60 Cycles
1 Phase

OUTPUT: 0 - 120/132 Volts,
1.25 Amperes
150/165 VA

APPLICATIONS

of POWERSTAT Type 10 are as innumerable as is the need for a variable a-c voltage control in today's low wattage electric and electronic equipment. It is ideal as the variable a-c voltage component in electronic tube testers; low wattage power supplies and rectifiers; low wattage heaters, furnaces, plastic molding equipment . . . and in any a-c voltage application where 50, 100 and 150 watt rheostats are now being employed.

A COMPACT VARIABLE A-C VOLTAGE CONTROL FOR LOW WATTAGE APPLICATIONS

To date, the many low wattage (50 . . . 100 . . . 150 watts) applications requiring variable a-c voltage control have had to be content with the inefficient, heat dissipating rheostats and other resistance types of control. With the introduction of the new POWERSTAT Type 10, the many advantages of POWERSTAT variable transformers are available for these low wattage requirements. A continuously adjustable output voltage from 0 to 120 or 132 volts is at the fingertips to control loads up to 165 VA. Type 10 does not have to be tailored to the load — it will deliver a variable voltage to any load up to its capacity. Type 10 is highly efficient — *does not* control by dissipating power in the wasteful form of heat. Other features: glass smooth commutator surface . . . advanced winding technique . . . superior core and coil design . . . rugged construction . . . single hole mounting . . . can be installed under a 3" chassis saving valuable space.

For additional information on the new, compact POWERSTAT Type 10, send for Bulletin P252.

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considered. However no process, the results of this study showed, could compete with the production of natural petroleum.

As a result of the experiments, several forecasts could be made:

- Low-cost raw materials would make possible many economies in plant design.
- Financing the first plant will be an important item. Improper financing could cause greater losses than could be offset by improved processes.
- Initial plant or plants would take advantage of maximum chemical production.
- To reduce total investment, the initial plant may be as small as is economically feasible.
- Lower pressures should be used if at all possible.
- Manpower requirements may not be as high as first estimated.
- Many processes and designs could be altered or eliminated to reduce initial investment.

Ideal location has not yet been found. However, Lake De Smet in northern Wyoming is inviting. The area is suitable for strip mining with coal laying close to the surface in beds 40 ft. or more thick. This coal could probably be delivered to the plant at 75 c. per ton or less.

How the Process Works (see cut): Coal would come to the plant by truck and then screened to remove $-\frac{1}{4}$ in. material. Fines would go direct to powerhouse. The $+\frac{1}{4}$ in. coal would go through a heavy-media separation plant.

About 70 percent then would consist of clean coal, which would go to grinding and drying. This coal, estimates show, would have a 6 percent ash on a dry basis, and would amount to 326 tons per stream hour with about 30 percent moisture content. The m.a.f. coal in this stream would amount to 205 tons.

The middlings from the cleaning plant, amounting to about 30 percent of the feed, would join the fines and go to the power plant for boiler fuel. The clean coal would be dried and crushed with hammer mills to a maximum size of 40 mesh. Screens and elevators would recycle any oversize material.

A conveyor then would take the pulverized coal to storage bins in the paste preparation building. Conventional paste-making equipment, similar to that in Louisiana, would be used. Paste storage tanks about 8 ft. in diameter by 12 ft. high would be supplied for each injection pump. The injection pumps would be direct steam-driven reciprocating duplex

pumps with a 100 gpm. capacity at 6,000 psi. discharge.

Liquid-phase hydrogenation, carried on at 6,000 psi., would be conventional in all respects except an additional net yield of heavy oil would provide necessary feed for the gasifier.

Paste exchangers would not be used but the product would be cooled by water coolers and by exchange with incoming hydrogen. Wash-oil scrubbing equipment would be included to maintain a hydrogen partial pressure of 75 to 80 percent in the liquid phase stalls. The three stalls included would have four 500 cu. ft. converters.

After the liquid-phase operation, heavy oil let-down (H.O.L.D.) from the hot catchpot would be depressured through conventional let-down valves to about 500 psi. From the let-down tanks the H.O.L.D. would split into two streams. One stream would feed the gasifier and the other recycled to the pasting operation.

Light oil from the cold catchpot would be depressured in two stages and then fed directly to the liquid-phase distillation column. The column would separate the product into three streams: (1) An overhead naphtha stream for tar acid recovery, (2) a bottoms stream of heavy oil, used for pasting operation, and (3) the balance of the material, which is fresh feed for the vapor-phase operation.

The vapor-phase hydrogenation unit would operate at 6,000 psi. and require 4,000 cu. ft. of reaction space. Two stalls, each with four reactors, are provided. Conventional high-pressure steam-driven reciprocating pumps and high-pressure exchangers would be used for the operation.

Products from the vapor-phase cold catchpot would be depressured in two stages and then go directly to the vapor-phase distillation unit. Here the product would be separated into: (1) bottoms that would be recycled to the vapor-phase stalls, (2) a high boiling gasoline fraction, (3) a feed fraction for the toluene-xylene platforming operation, (4) a feed fraction for the benzene platforming operation and (5) a light gasoline fraction.

Gases from the unit would go to the vapor-recovery plant. Aromatics would be extracted from the feed fractions going to the platformer.

After platforming, product would be distilled to obtain proper boiling range feed. Aromatics extracted would then be combined and redistilled to obtain benzene, toluene, toluene-xylene and motor fuel.

Gases from the platforming operation would go to the vapor-recovery plant where the C_3's and C_4's would be recovered and scrubbed with amine solution for H_2S removal.

Process Improvements: Many fea-

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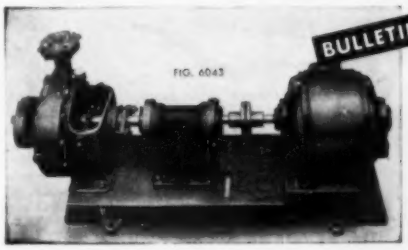

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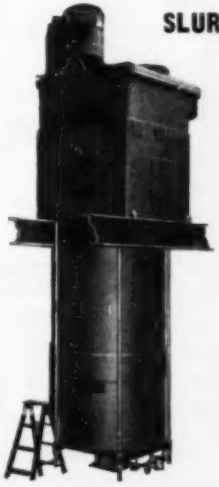

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tures incorporated in this new process will cut both investment and operating costs:

Lower pressures: Operating pressure was cut from 10,000 psi. to 6,000 psi. Low-rank coal is used. The elimination of extremely high conversion makes this possible. A coal conversion of 95 percent has been assumed.

High throughputs: Low rank coal gives higher throughputs per units of reactor volume.

Elimination of paste exchangers: Larger preheaters and cooling water units are more economical and give a higher coal concentration in the paste.

Improved gasification and disposal: H.O.L.D. from the hot catchpot is directly gasified for required hydrogen. Thus, conventional heavy oil work-up is eliminated, a great simplification. Feed is liquid now rather than finely divided solids.

Pasting costs less: Two liquid streams, H.O.L.D. and light oil bottoms, can be mixed directly into the paste. Storage and blending apparatus formerly required are eliminated.

Improved coal grinding and drying: High capacity hammer mills, followed by screening equipment eliminate fine material as soon as it reaches 40 mesh, paste size. Power requirements for coal grinding and drying are 7 hp. per ton compared to 24 hp. per ton in the former design.

Catalyst addition eliminated from pasting operating: Catalyst is added to the coal in the coal cleaning plant.

Low cost power: Low cost fuel in the power plant eliminates the need for high thermal efficiency.

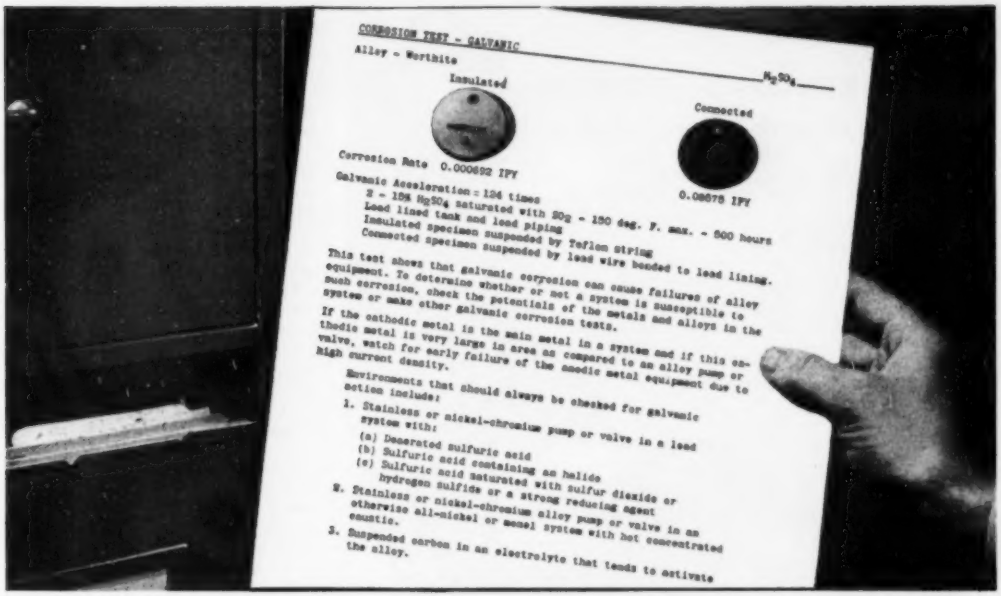
Cooling towers eliminated: Available water eliminates the need for cooling towers.

Use lower-purity hydrogen: Demonstration plant experience proves extremely pure hydrogen is not necessary. Result: No need for carbon monoxide scrubbing facilities in hydrogen manufacture and purification.

Elimination of liquid-phase gasoline from vapor-phase feed: Data from the demonstration plant shows that liquid-phase gasoline is satisfactory for motor fuel. This is particularly true in a plant producing chemicals that removes tar acids and bases.

Lower cost equipment: The direct steam-driven injection pumps cost about one-third less than electric-driven units. Larger steam requirements are offset by the low cost fuel. Pumps are operated with back pressure so that steam can be reused in the carbon dioxide scrubbing apparatus.

Elimination of coal storage: Since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This test shows that galvanic corrosion can cause failures of alloy equipment. To determine whether or not a system is susceptible to such corrosion, check the potentials of the metals and alloys in the system or make other galvanic corrosion tests.
If the cathodic metal is the main metal in a system and if this cathodic metal is very large in area as compared to an alloy pump or valve, watch for early failure of the anodic metal equipment due to high current density.
Environments that should always be checked for galvanic action include:
1. Stainless or nickel-chromium pump or valve in a lead system with:
(a) Deaerated sulfuric acid
(b) Sulfuric acid containing an halide
(c) Sulfuric acid saturated with sulfur dioxide or hydrogen sulfide or a strong reducing agent
2. Stainless or nickel-chromium alloy pump or valve in an otherwise all-nickel or monel system with hot concentrated caustic.
3. Suspended carbon in an electrolyte that tends to activate the alloy.

A CASE STUDY FROM THE WORTHINGTON FILES. This Worthington test sheet indicates that the galvanic action could be virtually eliminated in this manufacturer's system by *insulation*—that is, a complete separation of the alloy pump from metallic contact with lead surfaces. The recommendation was made to him as a result of a Worthington test made on the solutions his system was pumping.

It Takes More Than A Pump To Solve A Pumping Problem!

Worthington's files are packed with many stories like this one. Each is proof positive that you get a lot more than a Worthite* pump when you buy from Worthington.

It was the age-old problem of chemical pumping, corrosion. But this customer found a way out—a *practical solution* that saved him plenty of expense in extra maintenance and lost production time.

He wrote a letter to Worthington. Could we tell him whether there was anything he could do to slow down or stop this corrosion? He was pumping a 15% solution of sulfuric acid saturated with sulfur dioxide. Maximum temperature of solution was 150° F.

This wasn't a new problem for Worthington corrosion specialists. Experience had shown them that under these conditions galvanic action could be his trouble. They ran the test illustrated above which conclusively proved these assumptions correct.

Result? The customer insulated the system and his troublesome corrosion problem was brought under control.

At Worthington, we welcome the chance to hear about *your* pumping problems—either on a present installation or in the design of a new system. For it is only through such close contact with the industry that we can continue to build the kind of pumps and offer the kind of services that have led pump users the world over to the conclusion that *there's more worth in Worthington.*

Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, New Jersey.

*Reg. U. S. Pat. Off. C.1.6

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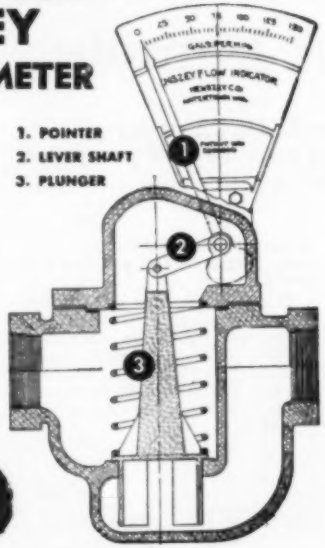

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coal supplies are close to the plant, a reserve coal supply is not necessary.

General plant facilities reduced: Because of eliminations, requirements for general plant facilities are less.

Output Debate: Located at Lake De Smet, Wyo., the proposed plant having a 15,000-bbl.-per-calendar-day would cost $174.5 million, according to the Bureau of Mines. Processing plant would require 950 employees and the mines, 100.

Although industry and government officials generally agree on the basic processing, they do not agree a 15,000-bbl.-per-day plant gives the best economies. A plant turning out 30,000 bbl. per day costs less to build and operate, according to Researcher E. E. Donath[8] of Koppers Co., Inc.

This plant would turn out 30,000 bbl. per day of chemicals and liquid fuels using 16,000 tons per day of run-of-mine coal with a 11,000 Btu. per lb. heating value, and 83 million cubic feet a day of natural gas. Plant costs, corresponding to $10,500 per daily barrel of products, would be $326 million.

Tar acid products amount to 6.1 percent by weight of the total output; the aromatics, 50.8 percent; LPG, 16.4, motor and aviation gasoline, 26.7. Value of these products per year, at present market prices: $135 million, about 40 percent of the plant cost.

Gasoline, LPG, ammonia and sulphuric acid from this plant would amount to only 0.2 to 2 percent of present U.S. production. But tar acids produced would be equivalent to 50 percent of 1950 production; aromatics equivalent to 54 percent, 18 percent of present benzene and 17 percent of present phenol production.

If erection of such a plant were started now, according to Donath, operation could not begin in less than three years.

Fischer-Tropsch: Vying with coal hydrogenation, the Fischer-Tropsch type of process is the largest potential user of synthesis gas made from coal. Besides its major products of gasoline and liquid fuels, the process turns out many oxygenated byproducts. These include ethyl alcohol and several higher alcohols, acetaldehyde and other aldehydes, acetone and other ketones, and acetic acid and other aliphatic acids.

Demand for these chemicals grows fast. Methanol, for instance, is now put out at the rate of 160 million gallons a year. Demand, recent studies indicate, may reach 875 million gallons by 1975. Methanol is now made from synthesis gas obtained from coke or natural gas; it most likely will be

made entirely from coal at that time.

Many alcohols higher than ethyl alcohol may be produced as major products by various modifications of the Fischer-Tropsch synthesis and the methanol synthesis, according to Alfred R. Powell* of Koppers. Today most of them are made from petroleum olefinic hydrocarbons. But synthesis may be the major source in 1975.

Synthetic ammonia is being made today at a rate of 1.8 million tons a year; by 1975, this rate may climb to 4.4 million tons. Currently it is produced from synthesis gas obtained from coke or natural gas.

Industrial hydrogen for the hydrogeneration of vegetable and animal oil comes chiefly from synthesis gas made from natural gas or coke. Today's production is about 30 billion cubic feet a year; this may go up to 150 billion by 1975.

If demand for Fischer-Tropsch chemicals in 1975 totals the estimated 15 billion pounds a year (six times present production), Fischer-Tropsch plants, to meet this demand, would have to turn out 700,000 bbl. of liquid fuel per day. Using the fluidized iron-catalyst technique, the processes would eat up 130 million tons of coal annually, according to Powell.

Texaco Process: Since the end of World War II considerable work has gone into improving the Fischer-Tropsch process. Recently, the Texas Co. announced it can now process any type of coal into synthesis gas under high pressure.

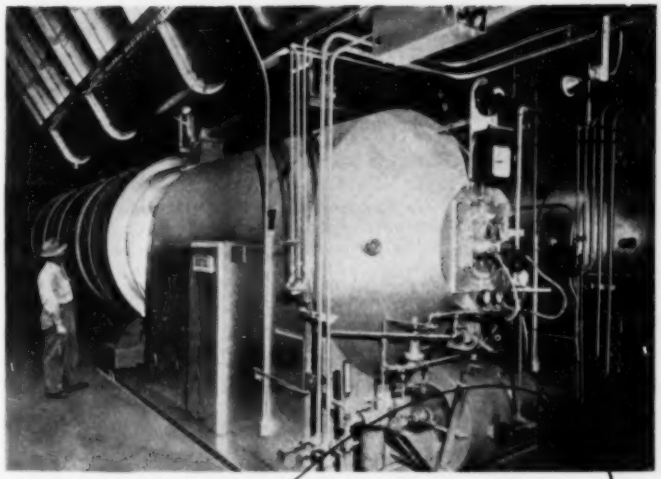
In preparing feed for the process, raw coal is ground mechanically to particle size suitable for check valves used in the feed pump. Because the particles are mixed with water, the grinding is done in a wet mill, eliminating the difficulties and hazards of combustible dust.

A slurry, prepared in a conventional thickner, varies from 40 percent coal and 60 percent water to 60 percent coal and 40 percent water. The density of the coal and its particle size determine the coal-water ratio. The slurry is then pumped through a heater.

The heated suspension, discharged under several hundred pounds pressure at temperatures that may exceed 1,000 deg. F., enters a reaction chamber.

Oxygen is fed into the reaction chamber through a separate water-cooled burner nozzle near the other feed nozzle or annular with it. Care is taken that the stream of pure oxygen does not strike the wall of the reactor directly. The reactor has a vertical cylindrical reaction space.

Molten ash flows through a restricted opening at the bottom of the



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QED, cont. . .

reaction chamber into a reservoir of cold water. When it hits the water, it disintegrates and is removed as a finely divided solid suspended in water. The product gas passes through a waste heat boiler.

The reactor, a pressure shell fitted with an internal coil, has water circulating through it. The water circuit can be connected to the waste heat boiler.

The generator is normally operated at a temperature above the fusion temperature of the ash. If the fusion temperature is higher than the desired reaction temperature, a fluxing agent may be added to the coal-water feed to help melt the ash.

In pilot plant operation, gasification has been as high as 95 percent, according to Dubois Eastman[1] of Texaco. Oxygen consumption rates ultimately expected are 15 to 20 thousand cubic feet per ton of dry coal with 80 to 90 percent of the heating value of the coal appearing as hydrogen and carbon monoxide in the synthesis gas.

Construction of synthesis plants, however, will create staggering new engineering problems, according to Eastman. The millions of gallons of water needed in a day will alone limit the location of synthesis plants.

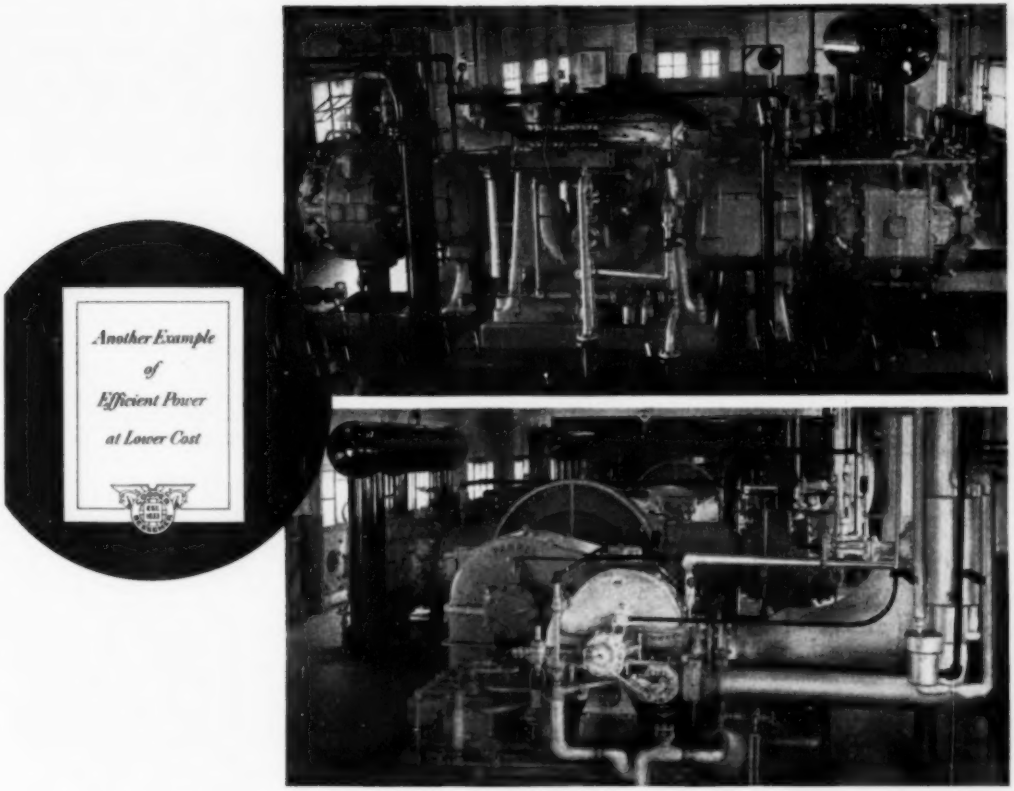
During World War II the peak production of oxygen was slightly more than 38 million cubic feet a day. A single synthesis plant turning out 10,000 bbl. per day of liquid product would require 100 million cubic feet of oxygen every day.

"Briefly, the possibilities are unlimited—but so are the obstacles," Eastman commented.

Underground Gasification is one possible way to cut costs. But the process has its share of obstacles. Much remains to be learned in gasifying extensive areas of coal deposits, in maintaining a dependable supply of gas of reasonably uniform quality, according to Gas Engineer Newman of the Bureau of Mines. And new problems of control keep popping up in the course of experimental operations.

At Gorgas, Ala., the Bureau of Mines, in cooperation with the Alabama Power Co., is running field-scale experiments. Here it can produce a 90 Btu. per cu. ft. gas with a straight blast of air. This gas, not rich enough for utility distribution, could be used only for power generation, particularly in gas turbines.

But by substituting an oxygen-steam mixture for air, the underground generation of synthesis gas may be feasible, Newman said. Right now large-scale model experiments using oxygen



In Processing Service . . .

COOPER-BESSEMER MOTOR OR TURBINE DRIVEN COMPRESSORS

. . . for continuous operation . . . for minimum down time

● The units shown above are Cooper-Bessemer M-Line compressors in Continental Oil Company's Billings Refinery. They are turbine driven, with reduction gears, and are handling vapor and recompressor gas through 2 stages, from 17 psi to 253 psi discharge.

During their two years of continuous operation, these units have shown a typical M-Line record — smooth, trouble-free performance, minimum down time and completely satisfactory behavior in general. The reasons are simple. Combined in these units are many of the features that have contributed to the success of Cooper-Bessemer engine-driven horizontals and modern V-Angles — features that come only from years of practical experience and painstaking development work in compressor design and construction.

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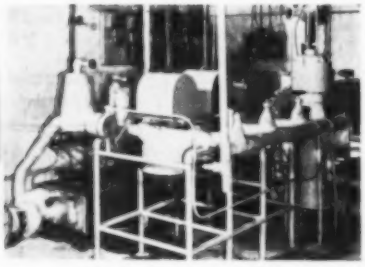

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Operating records show greater uniformity of product, freedom from oxidation, accuracy within 1/10 of 1% . . . as direct results of installing this continuous production system.

IF YOU BLEND OR MIX 2 OR MORE LIQUIDS . . . . . .

There's an experienced Bowser sales engineer in your vicinity who will gladly check your present liquid processing methods. He'll be glad to tell you how production can be increased and costs cut, and at no obligation to you.

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and steam are going on in Belgium. Other experiments are going on in French Morrocco, Italy and Britain. As it has in the past, the U. S. will probably have much to gain from European experience in the gasification of coal.

REFERENCES

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DISTILLATION

. . . a Design Problem

In a distillation system the design of boilers is usually regarded simply as a problem of determining the heat transfer surface needed for a given rate of heat transfer and temperature difference. However, sometimes, a knowledge of surface effects is important. British engineers F. H. Garner and W. S. Norman in a recent *Chemistry and Industry* describe a specific example.

In a certain manufacturing process an unstable organic compound was batch distilled under high vacuum (about 4 mm. of mercury absolute). Preliminary experiments in glass showed that the distillation proceeded smoothly and was not affected by the presence of metal strips immersed in the boiling liquid.

When the process was transferred to a small pilot plant whose still was constructed to mild steel the first batch polymerized and decomposed. But subsequent batches distilled without appreciable decomposition.

Finally, when the process was tried out in a larger still the distillation proceeded smoothly as long as there was only a depth of 1 ft. of liquid in the boiler. But with a full charge of 2 ft. depth, decomposition occurred so fast it was impossible to carry on the distillation.

The decomposition of the first batch in the pilot still was most probably a surface effect, since the trouble disappeared when the surface had become coated with decomposition products. The results obtained with the larger still demonstrate the effect of hydrostatic pressure on super-heating when distillation is carried out under vacuum.

MEMO FROM THE EDITOR

Continued from page 137

new type of furnace, first in the U. S. and second of its kind in the world, would be used.

We scouted around, found out that the furnace was developed by Elektrokemisk A/S of Oslo. We got in touch with Arne Solem, an engineer-editor there who keeps his eyes open for us on Norwegian developments.

But Elektrokemisk wasn't quite sure they wanted to say anything just yet—after all, it was a brand new thing. So we tackled Elektrokemisk's people in New York, Drs. Larsen and Ydstie. "What about it," Joe O'Connor asked. "This is something American chemical engineers ought to know about."

"Wonderful idea," they said after discussing the whole thing in Norwegian, "but we'll have to persuade our people in Norway first." Then for months there was a steady flow of cables and letters between New York and Oslo.

Meanwhile, we had some information—but promised not to publish it until the O.K. came from Norway. Finally one day Dr. Ydstie called Joe over to his office.

"We've got the permission," he said, "now let's work it up." He was all excited (partly because his wife was expecting their first baby almost any minute).

Finally the item was finished. Then Joe worked up a simple sketch—a 16-sq. in. sketch condensed from 8 sq. ft. of engineering drawings! Meanwhile the Elektrokemisk people in Norway had pictures taken of the first unit to operate. It was at a plant in Sweden.

Then the whole package was air mailed to Oslo where Dr. Sem, Elektrokemisk's technical director, checked it for accuracy.

So into that 1.5-page technical news item that you may have read in our March issue went more than eight months of work and follow-through (and Lord knows how many telephone calls, letters and cables).

But it was worth every bit of time and effort, for our story is still the first technical information to be published anywhere on this important new Norwegian development. We're betting that Elektrokemisk furnaces will be common things in this country within a few years.

Now I hope you'll agree with me that it's an exciting—and sometime a tough—game to get those timely developments we dig out and bring to you every month.

There's often a long, long story behind a short technical news items.

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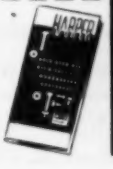

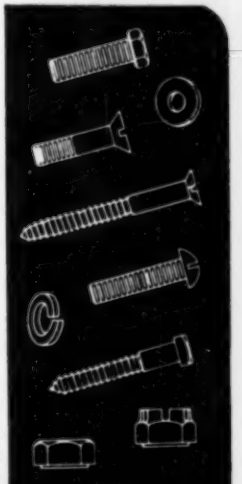

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HOOKER CHLOROBENZENES

MONOCHLOROBENZENE

Synonym: Phenyl Chloride
Formula: C_6H_5Cl
Appearance: clear, colorless liquid

TYPICAL PROPERTIES

Molecular Weight	112.5
Freezing Point	−44°C
Distillation Range	131.2° to 132.2°C
Specific Gravity, 15.5°/15.5°C	1.114

USES

INSECTICIDAL INTERMEDIATE: DDT and other insecticides.

DYESTUFF INTERMEDIATE: sulfur black and brown dyes.

CHEMICAL INTERMEDIATE: organic synthesis.

SOLVENT: paints, varnishes, lacquers, paint removers; general use.

HEAT TRANSFER FLUID: suggested for condensing vapor systems, such as glass enameled vessel jackets, which cannot stand high steam pressures.

ORTHODICHLOROBENZENE

Synonym: 1, 2-Dichlorobenzene
Formula: $C_6H_4Cl_2$
Appearance: clear, colorless liquid

TYPICAL PROPERTIES

Molecular Weight	147.0
Freezing Point	−18° to −22°C
Distillation Range	4° incl. 179.5°C
Specific Gravity, 15.5°/15.5°C	1.310

USES

INSECTICIDE: termites, powder post beetles, wood borers, midges, flies, roaches, bed bugs, etc.

SOLVENT: gums, resins, tars, rubber, greases, oils, fats, waxes. Readily emulsified.

DEGREASING AGENT: metals, leather, hides, wool.

INTERMEDIATE: organic chemicals, dyestuff intermediates.

IN COMPOUNDED SPECIALTIES: metal cleaners, polishes, paint and varnish removers, etc.

HEAT TRANSFER FLUID: suggested for condensing vapor systems in temperature range 180° to 200°C.

PARADI®

(Hooker Paradichlorobenzene)
Synonym: 1, 4-Dichlorobenzene
Formula: $C_6H_4Cl_2$
Appearance: white crystals
7 SIZES—Pea No. 1, Pea No. 2, Rice No. 1, Rice No. 2, Rice No. 3, Granulated, Powdered.

TYPICAL PROPERTIES

Molecular Weight	147.0
Melting Point	53°C
Boiling Point	173°C
Flash Point	73°C

USES

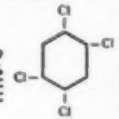
INSECTICIDE—REPELLENT: peach tree borers, black peach aphids, tobacco blue mold, clothes moths, carpet beetles, fish moths, garden centipedes.

HERBICIDE: used in cranberry bogs.

DEODORANT: in sanitary specialties, disinfectants.

INTERMEDIATE: organic synthesis; many dyestuffs including sulfur, azo, anthraquinone.

1, 2, 4, 5-TETRACHLOROBENZENE



Formula: $C_6H_2Cl_4$
Appearance: white flakes

TYPICAL PROPERTIES

Molecular Weight	215.9
Chlorine Content	65.7%
Melting Range	137.5° to 140°C
Distillation Range	240° to 246°C

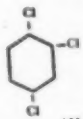
USES

INTERMEDIATE: 2, 4, 5-trichlorophenol; 2, 4, 5-trichlorophenoxyacetic acid; azo dyes.

INSECTICIDE: slightly active; suggested for dusting powder formulations.

IMPREGNANT: for fire and moisture resistance, electrical insulation; temporary protection in packaging.

TRICHLOROBENZENE, Tech.



Formula: $C_6H_3Cl_3$
Appearance: clear, almost colorless liquid

TYPICAL PROPERTIES

Molecular Weight	181.5
Freezing Point	10°C
Distillation Range	205° to 235°C
Specific Gravity, 15.5°/15.5°C	1.465

USES

INSECTICIDE: soil poison for termites.

SOLVENT: fats, oils, waxes, resins; crystallization solvent.

HEAT TRANSFER MEDIUM: condensing vapor systems, 210° to 300°C.

DIELECTRIC FLUID: transformers.

INTERMEDIATE: dye intermediates, other organic chemicals.

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3 **Totally Enclosed Fan Cooled Motor**—protects against dusts, mist or fog that might be detrimental to the vital parts of the motor. The inner frame protecting the motor is sealed to keep out harmful matter.

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What's Good in the Eighth?

Here we go again. For the eighth time we pick the winners and also-rans in the newest volume of the Encyclopedia of Chemical Technology. Here's what you can expect.

You and I are getting pretty familiar with the Encyclopedia of Chemical Technology. After studying seven volumes together we have come to appreciate its strength. And to sympathetically regret its weaknesses.

Its strength, of course, is founded on its many fine survey articles of the industries, materials, arts and techniques in American chemical technology. Its strength, therefore, is its authors. Each good one that does his job properly adds to the over-all value.

Weakness in ECT is also authors. There are those who write too little. There are those who write far too much. There are experts who write only for other experts. So weakness is caused by authors who can't or won't meet the prime requisite; an authoritative article by an articulate expert for an intelligent non-expert.

In Vol. 8* we find both good and bad. Qualitatively, though, we can say that it is better than average. Its 80 authors give us about 50 articles. They range from Ion Exchange (by Robert Kunin of Rohm & Haas) to Metal Plating ("see Electroplating; Metallic Coatings").

Let me tell you what to expect in your copy.

There are six surveys of whole industries. Lamp manufacture includes gas mantles, electric, fluorescent and miscellaneous lamps. Laundering is included as an important consumer of chemicals. Leather and tanning are nicely treated in Fred O'Flaherty's usual competent style. Manufactured gas, matches and meat—an appropriate combination—are the remaining trio. The editors have denied my accusation that some excess fat should have been trimmed from the article on meat and meat products.

There is a quintet of articles that I have classed as supplementary arts and sciences. I include lubrication, mass spectrometry, metallography and metallurgy. If your duties or interests take you to any of these five you'll find them good surveys.

I have a category of materials—with three subdivisions: classes, individuals and products. By classes I mean ketenes, ketones, ketonimine dyes, lactones, lipides, mercaptals and mercaptans. The individuals in Vol. 8 include the metals with their alloys and their compounds: iron, lead, lithium, magnesium, manganese, mercury. Also itaconic acid, lactic acid, lecithin, lignin, lignite, lime, maleic acid, malonic acid. The four that I call products are laminated products (these exclude plywood), linen, linoleum and margarine. These might be called industries, but the emphasis is on a single thing. Meat is an industry, margarine is a product. Leather an industry, linoleum a product.

My last group includes theories and properties: isomerism, isotopes, magnetic properties, the metallic state, low temperature technique, melting and freezing temperatures. All are competently done and properly included. Also in my last grouping of related information are the articles on laboratories which covers design and use, lead poisoning, literature survey (including mechanical searching), mercury preparations, malaria chemotherapy. Last and least: materials of construction.

Materials of construction merits more than 23 lines. It should have been the equal in value, if not in length, to the 40 excellent pages on corrosion in Vol. 4. It should at least have had a bibliography. The editors, if they suffered from author trouble, had plenty of names to solicit. Those that come immediately to my mind: Uhlig, Fontana, Speller, Friend, Pratt, Lee and Fetter (formerly with *Chemical Engineering* and founder of our Corrosion Forum).—*LBP*

* Encyclopedia of Chemical Technology. Vol. 8: Ion Exchange to Metal Plating. Edited by Raymond E. Kirk and Donald F. Othmer. Assistant Editors: Janet D. Scott and Anthony Standen. Interscience Encyclopedia, New York. 944 pages. Subscription price $25.

TEST YOURSELF: A 20-question, true-or-false quiz based on Vol. 8. (Answers on p. 322.)

History . . .

1. The manufacture of leather and its processing probably constitute the oldest manufacturing industry of man. T☐ F☐
2. The term "beta iron" is no longer used. T☐ F☐
3. Development and use of the thoria gas mantle ultimately led to the development of the rare earth industry. T☐ F☐
4. Linen is the oldest known textile material. T☐ F☐
5. The usefulness of lubrication was known by the chariot drivers of 1400 B.C. T☐ F☐
6. Earliest uses of malt were primarily for the production of beer or other fermented beverages. T☐ F☐
7. Records of operations since 1499 show a total output of some 300,000 tons of mercury. T☐ F☐

Current Technology . . .

8. Ion exchange may be considered in the field of chemical engineering as a unit operation. T☐ F☐
9. Isomerism has been assuming increasing importance in inorganic chemistry. T☐ F☐
10. The laundry industry is considered to be a part of the maintenance branch of the textile industry. T☐ F☐
11. Most of the compounds of lead are prepared from the monoxide. T☐ F☐
12. Temperatures of the order of 0.001 deg. K. have been obtained. T☐ F☐
13. Use of dog and pigeon manure was discontinued with the introduction of Oropon bates by Rohm & Haas. T☐ F☐

Sad, If True . . .

14. Lithium nitrite is even less important than the nitrate as far as industrial uses are concerned. T☐ F☐
15. The most comprehensive text on the analysis of leather is now out of print. T☐ F☐
16. The price of mercury is largely controlled by the European cartel. T☐ F☐
17. Today, after thousands of years, the processes of tanning are still steeped in the depths of empiricism. T☐ F☐

A Short (But Merry) Life . . .

18. The carbonyls of iron are volatile, extremely toxic, very reactive and their vapor-air mixtures are violently explosive. T☐ F☐
19. Toxicity of tetraethyl lead is purely a function of its lead content. T☐ F☐
20. Sulfonamides are not causal prophylactic drugs against vivax or falciparum, nor do they cure vivax malaria. T☐ F☐

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Drugs

A STUDY OF ANTIMETABOLITES.. By D. W. Woolley. John Wiley & Sons, New York. 269 pages. $5.

Reviewed by Aaron Arnold

The suggestion of Fildes in 1940 that useful chemotherapeutic agents against infectious diseases might be produced by altering the structure of vitamins and other metabolites to achieve antagonistic analogs has aided in the opening of what promises to be a new and fruitful field of research. Thus, compounds have been synthesized which can block the metabolic functions of vitamins, amino acids, hormones, purines, and pyrimidines. The monograph serves as an introduction to the subject and to an understanding of the underlying principles whereby such blocking agents may be developed. Distinctions between reversible and irreversible blocking agents are also discussed.

Since drugs are considered to effect their activity by blocking one of the body's metabolic pathways, the author points out that the study of antimetabolites will also aid in clarifying cellular physiology. Examples of this are included.

The wealth of information the author brings to bear in the discussion of the principles involved in the development of use of antimetabolites serves to make this a uniquely useful monograph for those in chemistry, chemotherapy, pharmacology, and related fields.

Science and Philanthropy

COTTRELL: SAMARITAN OF SCIENCE. By Frank Cameron. Doubleday & Co., Garden City, N. Y. 414 pages. $4.50.

Reviewed by H. C. Parmelee

If ever boyhood activities were prophetic of the zeal and industry of later years, the youthful interests of Fred Cottrell faithfully foreshadowed many of the traits that characterized his long and distinguished career in the field of science.

The restless energy of his teenage mind led him, alone or in partnership, into such varied lines of business as that of a job printer, commercial photographer, electrician, and chemist. When telegraphy attracted his attention he organized the boys of the neighborhood into the Occidental Telegraph Co. But his crowning venture was the publication of *Boys' Workshop*, a weekly medium of four pages "dedicated to the public in general and boys in particular." By

an odd coincidence one issue of this up-and-coming magazine contained an article on "The Progress of Science" in which readers were told of "the deposition of smoke and dust by electrical aid."

Although Cottrell was best known the world over for his development of electrical precipitation of dust and fume, that was but a highlight in a fabulous career of wide and varied interests. His mind embraced such strangely assorted subjects as thermodynamics and Esperanto, nitrogen fixation and a novel banking system, physical chemistry and model towns, helium production and cooperative colonies, gas fuel cells and bird banding.

If a subject interested him, and particularly if it posed a problem that challenged solution, he gave himself to it with the zeal of a missionary and the tenacity of a bulldog. In his capacity for keeping many irons in the fire he was at once the pride and despair of his friends and associates, who felt that he was scattering his energies. To this criticism his customary reaction was that perhaps he was at his best as a catalyst, offering a suggestion here and an idea there, trying to help all with whom he came in contact whether they sought his aid or not. His generosity was matched only by his tremendous enthusiasm, optimism and energy.

An early clue to the guiding principle of Cottrell's life is found in his dedication of *Boys' Workshop* "to the public." In all that he undertook and accomplished it was his firm intention to serve the good of humanity. He scorned the profit motive for himself, but saw in it an opportunity to create funds to further research and aid worthy projects. And so, when he had patented his ideas on electrical precipitation, having conceived something for the good of humanity, he set out to find the means of administering his patents in the public interest. It was not an easy task. But ultimately through the help of Dr. Walcott, secretary of the Smithsonian Institution, and Dr. Arthur D. Little, he persuaded a blue ribbon group of successful, conservative business men to organize the Research Corporation. This body was to administer his patents and use the profits therefrom, not for private gain but to encourage and support further research. Some years were to elapse before the corporation could begin to carry out the philanthropic intent of its promoter.

Cottrell was intense in everything he did. He telescoped a four-year curriculum into three at the University of California which he entered at the age of sixteen by taking en-

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trance examinations. His postgraduate work at Leipzig was marked by such driving concentration that after receiving his doctorate *summa cum laude* he experienced a slump, physical and mental, that was a matter of great concern to him. But some months later he snapped out of it and was again his energetic self. From that time on he was prodigal of his time and energy, and gradually burned himself out.

It was inevitable that fame and honor, but not fortune, should come in full measure to this brilliant genius. He received the Perkin and Hollcy Medals; the Modern Pioneer, the Washington, the Willard Gibbs, and the American Institute of Chemists Awards; and was elected to the National Academy of Sciences. Although Industry (with a capital I) repeatedly and insistently sought his services at fancy salaries, he always declined a highly remunerative industrial post and cast his lot with an organization in which he saw an opportunity for public service with less financial reward. He filled public positions of high honor—director of the Bureau of Mines, and of the Fixed Nitrogen Research Laboratory, chairman of the division of chemistry and chemical technology of the National Research Council, and member of numerous commissions.

No stretch of the imagination is required to believe that home life and domestic relations meant little to a man so completely preoccupied with ideas and ideals. During his courtship of Jessie Mac Fulton he made it crystal clear that after their marriage his work must always come first, as indeed it did. "Golf widows" may have to endure lonely weekends, but Mrs. Cottrell learned to spend weeks and months alone while her husband pursued his pet projects over the United States and Europe. It was she who had to adapt her life and interests to his. Toward the end she gained some measure of control over him and insisted on vacations, but even these usually ended with some new attraction, such as hydroponics and air-conditioned greenhouses, that captured his imagination and absorbed his energies. Nevertheless she was a genuine helpmate, and shared with his close friends their profound respect for his achievements, their humor at his foibles, and their deep concern for his utter disregard for his health. Her death was followed in a few months by his own sudden demise at a meeting of the National Academy of Sciences.

Recent Books & Pamphlets

Subject	Summary	How to Order
Pumps	How to select pumps for a chemical plant. For various classifications—data on characteristics, size, materials of construction, accessories, typical applications, advantages and disadvantages. Numerous cross-sectional drawings show operating principles, graphs show performance. 15 pages.	Reprint No. 187. Editorial Dept., Chemical Engineering, 330 West 42nd St., New York 36, N. Y. 25 cents.
Atomic Energy	Seventeen papers deal with the broad aspects of the Atomic Energy Program as well as the highly technical. Covers the economic situation, engineering and objectives of AEC, separation of stable isotopes, instrumentation and control of reactors. 509 pages.	"Role of Engineering in Nuclear Energy Development." TID 5031, Office of Technical Services, Dept. of Commerce, Washington 25, D. C. $1.40.
Manpower	How management gets the opinions of its engineers, what engineers want to know about management policy, the media of engineering-management communication, developing management potential in trained engineers, recommendations on how to improve industrial communication. Report on a nationwide survey. 46 pages.	"How to Improve Engineering-Management Communications." National Society of Professional Engineers, 1121 Fifteenth St., N.W., Washington 5, D. C. $2.
Air Pollution	Preface and outline of the association's manual which is being published serially as the various chapters are finished. 8 pages.	"Manual Sheet P-1, Air Pollution Abatement Manual." Manufacturing Chemists' Assn., 246 Woodward Bldg., 15th and H Sts., N.W., Washington 5, D. C. 15 cents.
Flammability	Flammability limits of 155 substances in air and in oxygen.	"Limits of Flammability of Gases and Vapors." By H. F. Coward and G. W. Jones. Bulletin 503, Bureau of Mines. Supt. of Documents, Washington 25, D. C. 40 cents.
Welding	Basic information on the application of the various welding processes to the non-ferrous metals. Photographs of current practices, diagrams of equipment, graphs, tabular data. 553 pages.	"Welding of Non-Ferrous Metals." By E. G. West. John Wiley & Sons, 440 Fourth Ave., New York, N. Y. $8.50.
Uranium	Revision of a popular pocket-sized hand-book for uranium prospectors. Eight color reproductions of common uranium bearing ores. Latest official AEC price circulars.	"Prospecting for Uranium." Supt. of Documents, Washington 25, D. C. 45 cents.
Rubber	Report on a battery of tests which prove that the addition of Bentonite to latex is a great boon to flow casting. Published in a recent issue of *Rubber Developments*.	Natural Rubber Bureau, 1631 K St., N.W., Washington 6, D. C. Gratis.
Industrial South	An encyclopedia of business activity in the South. Alphabetical index of 3,000 large manufacturing plants with names of executives, principal products and number of employees. Maps, charts and pictures illustrate industrial activities in 14 states. 60 pages.	"Southern Industrial Directory, Southern Assn. of Science and Industry, 5009 Peachtree Rd., Atlanta, Ga. $5.
Stainless	Graphical summary of elevated-temperature data for the commercially produced stainless steels. Summary curves for tensile strength, 0.2 percent offset yield strength, percent elongation, percent reduction of area. 116 pages.	Special Technical Publication 124. By Ward F. Simmons and H. C. Cross. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $4.
Productivity	Coke, cement, paper and pulp, synthetic fibers, and many other industries are covered.	"Productivity Trends in Selected Industries — Indexes Through 1950." Bulletin 1046, Bureau of Labor Statistics. Supt. of Documents, Washington 25, D. C. 45 cents.
Humidity	Methods of measuring water vapor content of gases and for producing atmospheres of known humidity are reviewed.	"Methods of Measuring Humidity and Testing Hygrometers." Circular 512, Bureau of Standards. Supt. of Documents, Washington 25, D. C. 15 cents.
Coal	Each year the staff of the fuels division of the bureau summarizes the results obtained and the status of research programs for a number of projects of general chemical engineering importance. This is one of the series.	"Annual Report of Research and Technologic Work on Coal, Fiscal Year 1950." By Arno C. Fieldner and S. Gottlev, IC 7618, Bureau of Mines, Pittsburgh 13, Pa.

Answers to 20-questions quiz on page 319: All statements are true.

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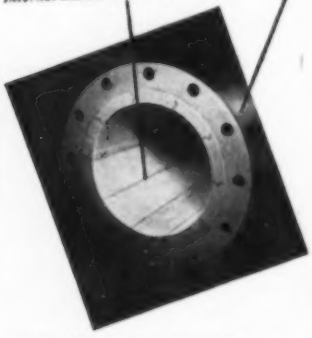

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Pumps	. . . effect a real saving by using the right pump on each job. Pumps developed for the chemical industry are illustrated and described. Some practical engineering pointers relating to chemical problems. For various models: ratings tables; intricately labeled cross sectional drawings; photographs. 36 pages.	Buffalo Pumps, Inc.
Fans	. . . select and install ventilating and exhaust fans. Specifications, dimensions drawings, photographs of a whole line of industrial fans. 28 pages.	Chelsea Fan & Blower Co.
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Dust Collectors	. . . install, use and maintain a new cloth-bag dust collector for carbon black, cork, fine wood, graphite, pigments, lime, soap, metal oxides and similar dusts. Photographs, line drawings, elevation drawings. Specifications of standard collector sizes and dimensions. 8 pages.	Pangborn Corp.
Pumps	. . . handle clear liquids, sewage and other liquids containing solids with wet or dry pit type sump pumps which come in eight sizes, 1½ to 8 in. Specifications, construction and dimension drawings. 8 pages.	Warren Steam Pump Co.

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Chemicals	. . . use and apply products of this company's chemical division including aldehydes, ketones, solvents, acids and glycols. Lists physical and chemical properties. Specifications, shipping, handling and toxicological data.	Celanese Corp. of America
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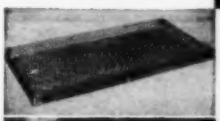
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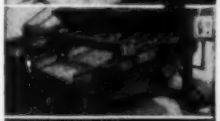
straining?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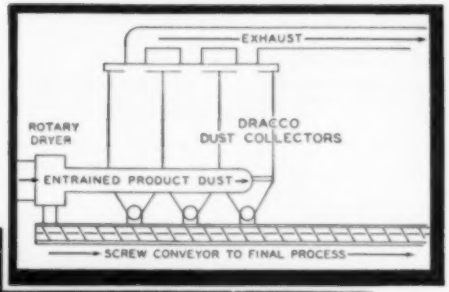

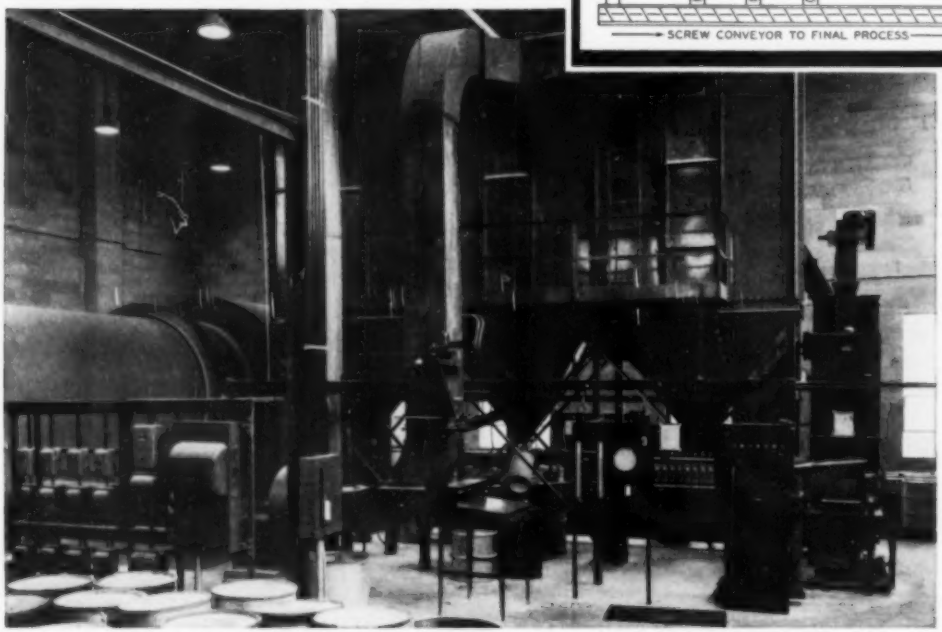

Dracco Filter (center) at Ferro's Bedford plant recovers all napalm entrained in hot air exhaust from rotary drier (left). Diagram indicates how recovered material is discharged to screw conveyor, which moves all napalm to final processing.

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The Ferro Corporation knows that today's industrial conditions with their high costs and accelerated production demands make peak-efficiency operation a must!

At its Bedford (Ohio) napalm manufacturing plant, Ferro is using Dracco Dust Control Equipment, which assures high efficiency by recovering 1% to 5% of the napalm processed.

Napalm is used to make jellied gasoline for fire bombs and flame throwers, and during processing, it is dried in a huge rotary drier with a blast of 320° F. air. This blast entrains fine napalm dust, which would be lost except for the reclaiming action of Dracco Equipment.

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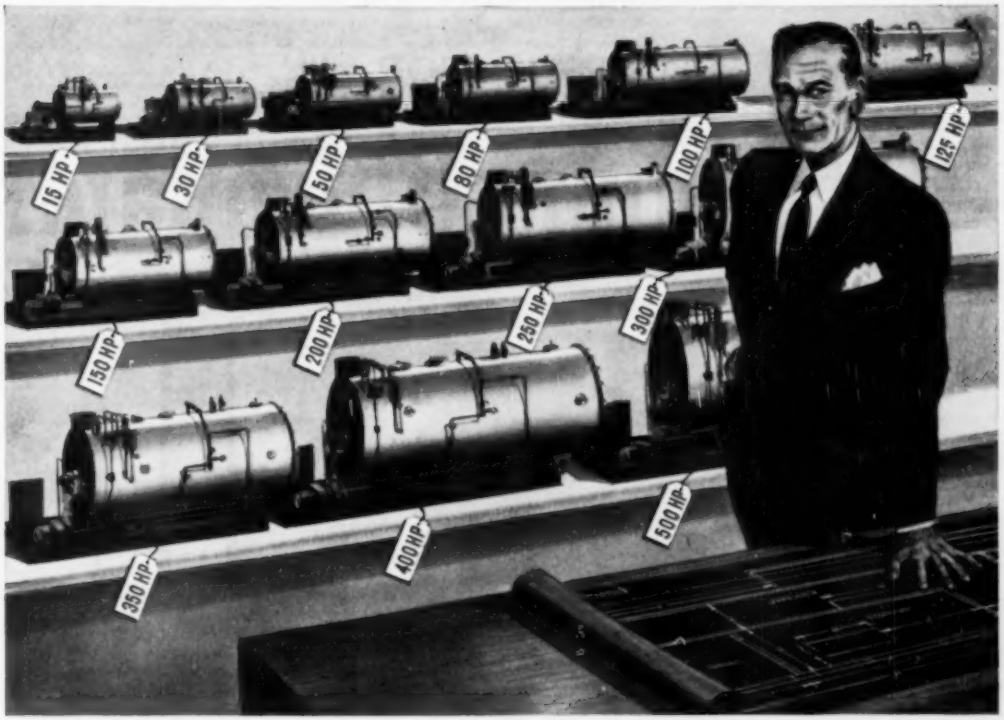

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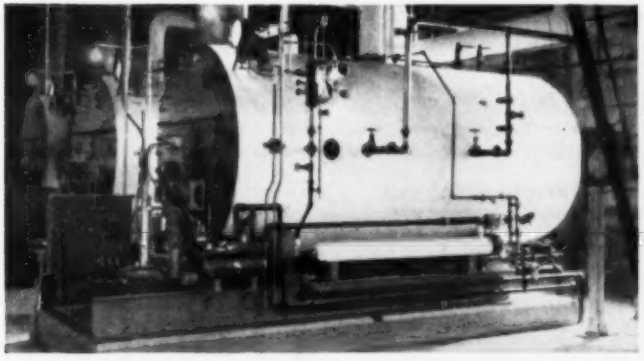

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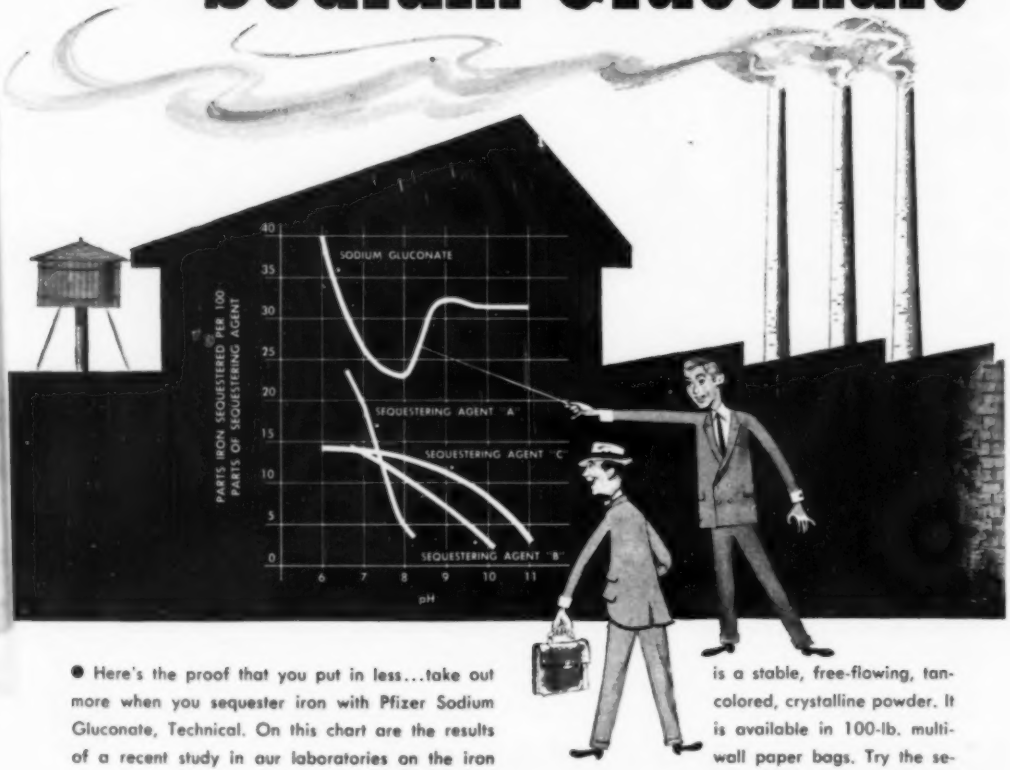

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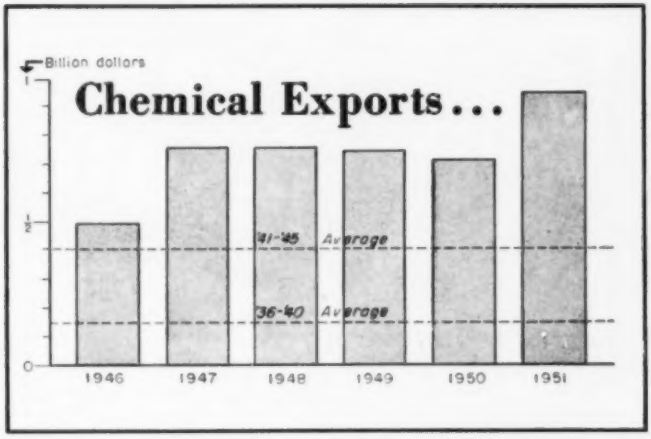


...On the Way Up

Exports by U. S. chemical firms reversed a trend and went up again last year. Increased production has made it possible to relax controls.

In 1951 this nation's exports of chemicals and related products were valued at nearly $1 billion. This represents an increase of more than 30 percent over the 1950 total. And this steep rise reversed the downward trend that began in 1947.

The increase in the number of chemical installations abroad evidently has little impact on the trading opportunities available to American concerns.

Analysis of the export figures reveals that as new plants go up overseas, demand for U. S. chemicals varies but does not diminish. The old truism that industrialization overseas means more business for American firms evidently applies to chemicals.

At the beginning of last year it appeared that carbon black exports would have to be severely curtailed. Both channel and furnace grades were restricted to a rate of about 300 million pounds a year.

But as 1951 progressed, production of both grades picked up noticeably and by year's end—despite newly created and aggressive carbon black industries in both Britain and Germany—U. S. carbon-black exports set an all-time high.

▶**Organics Go Up**—In early 1951 styrene was diverted to synthetic rubber production. The polystyrene shortage became acute and many American plastic firms were on the verge of shutting down. Exports, accordingly, were severely slashed.

But as the natural rubber supply picture brightened it became possible to cut back the synthetic rubber program. That eased the styrene supply. And when benzene production started perking up quotas on polystyrene went overboard.

The supply of plastic-type nylon has improved so that the Office of International Trade has liberalized its licensing policy. Polyethylene—still not abundant—is being shipped overseas in increasing quantities.

Phenothiazine, used widely in sheep growing areas, is being made available to overseas purchasers after several months of voluntary export control by domestic producers. And export programs for acetone are being raised.

▶**Sulphur's Tight**—World production of sulphur continues to lag behind consumption. Because of its high purity and low cost, U. S. sulphur is in greatest demand.

At the same time, foreign users are trying to develop new sources of supply—despite the generally higher costs involved. This has meant utilization of higher cost sulphur and conversion of equipment to utilize pyrites or other sulphur-bearing materials.

The need for increased supplies has focused interest on certain marginal deposits (30 to 50 percent), and some quantities are beginning to appear in domestic and foreign trade. Exploitation of these deposits is encouraged by Washington. This marginal sulphur can be shipped abroad and the shipment is not charged against the export quota.

This has given rise, however, to a new problem in sulphur export control. Despite the higher costs of this marginal sulphur it can still compete with foreign sources.

It is not yet clear what effect the new source will have in easing the sulphur crisis. Both industry and government are watching the experiment with great interest.

▶**Cobalt Compounds**—Scarcely any commodity is in tighter supply than cobalt. The U. S. is a large consumer of cobalt but has no resources from which it is feasible to derive the metal or its compounds. Most cobalt used here comes from a crude alloy produced in the Belgian Congo.

Many nations—especially in Latin America—are completely dependent on this country for supplies of cobalt driers, such as the naphthenate. Among the small amount of cobalt exports for which licenses are granted, OIT gives special consideration to applications for printing-ink driers.

Cobalt oxide is another chemical that figures importantly in foreign trade. When used in the finishing of metal enamelware, OIT has considered the export request to have a high order of urgency.

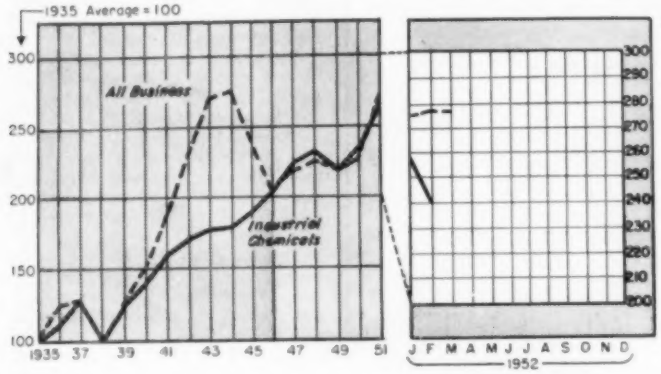
In cases where nations have access to a supply of cobalt raw materials but lack the processing facilities, the U. S. has arranged to export the end product in return for an equivalent amount of cobalt.

Exports of both antibiotics and bismuth compounds are rising. In both cases increased output at home is an important factor in the trade picture.

Exports of antibiotics have skyrocketed since the war. The value of penicillin exports in 1950 was more than 18 times the value of all drugs and medicinals shipped from the United States in 1938. This despite the fact that ECA financing was responsible for the construction of several antibiotics plants abroad.

Process Industry Trends

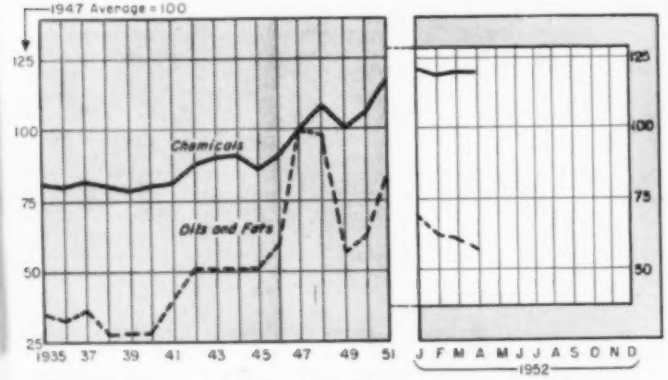
CONSUMPTION



Industrial Chemicals Index

	Feb. (Est.)	Jan. (Prelim.)	Dec. (Revised)
INDEX	240.30	258.94	242.57
Fertilizer		57.82	53.55
Pulp and paper		38.37	27.65
Petroleum refining		26.72	26.75
Iron and steel		16.73	16.29
Rayon		28.02	26.78
Glass		20.70	17.81
Paint and varnish		20.75	19.27
Textiles		11.12	9.56
Coal products		11.46	11.47
Leather		3.98	3.50
Explosives		8.10	7.76
Rubber		6.31	5.50
Plastics		16.86	16.68

PRICES



Chemical Engineering's Price Indexes

Chemicals: Down −0.6%
Oils and Fats: Down −8.3%

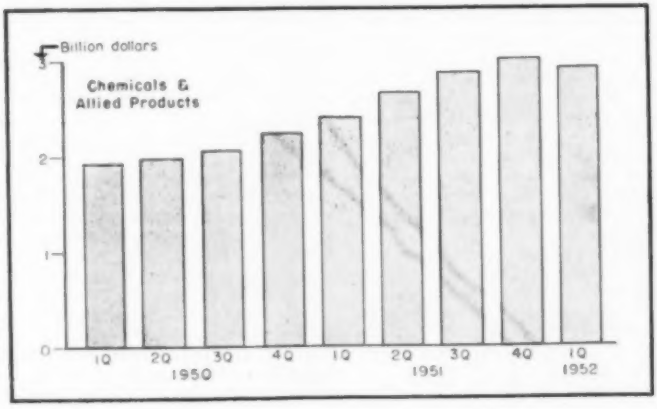
	Chemicals	Oils & Fats
As of April 1, 1952	120.04	56.14
Last month	120.71	61.23
April 1951	118.98	96.90
April 1950	99.92	55.72

HIGHLIGHT OF THE MONTH

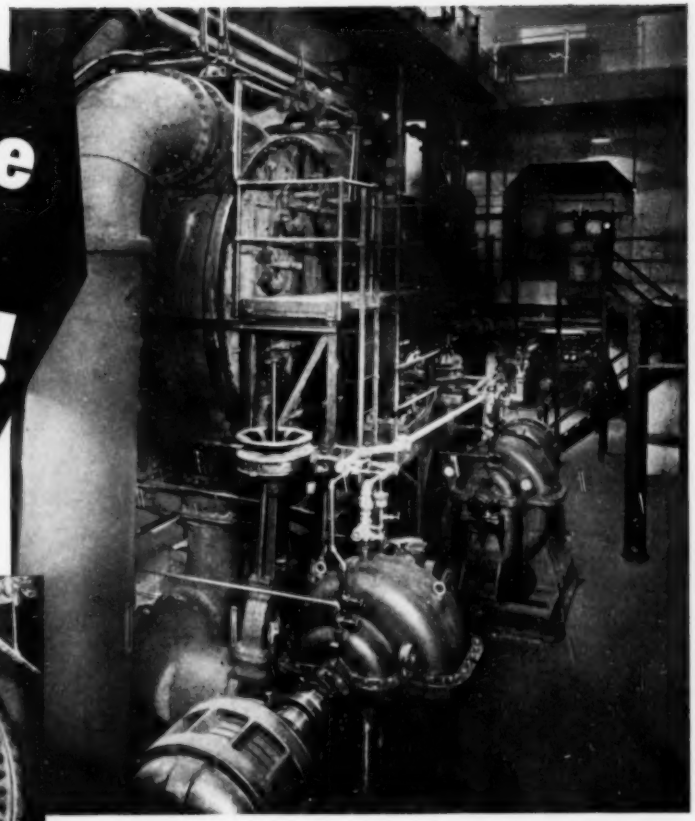
The Inventory Picture Brightens

Inventories of chemical and allied product manufacturers have stopped rising. Early 1952 figures indicate that stocks are beginning to decline. Of course some producers still have big inventories on hand. Others have sold off some of their products at a smaller profit than they expected. Still others have actually taken losses in order to get in a better inventory position.

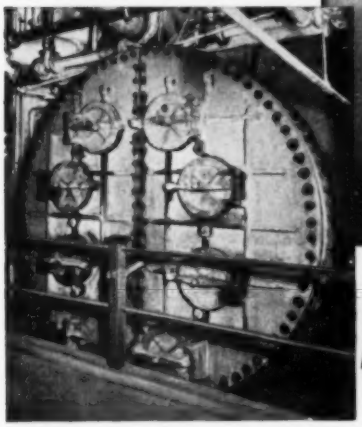
Both production and consumption continue relatively high, so inventories can not be expected to decline very rapidly in the near future.



Before you SCRAP!



Condenser of the Lynn Gas & Electric Co., Lynn, Mass., which was returned to service by use of inlet-end inserts at a saving of $30,000.



Before you scrap condenser tubes because of inlet-end leaks

GET ALL THE FACTS

It sometimes happens that a combination of erosion and corrosion at the inlet ends of condenser tubes may seem to force their replacement. This is not always necessary. If the damage is confined to a small area at the inlets, and the tubes otherwise are in good condition, they can be saved by using inserts designed especially for just such circumstances. There are several makes available, none made by Revere.

In a recent case, involving a condenser of the Lynn Gas & Electric Company, Revere recommended inserts. Here are the figures: Number of tubes involved, 4,100; Replacement cost, $35,000; Cost of inserts to cure the trouble, $5,000; Saving, $30,000. Repairs should enable the condenser to serve for several more years. The work was so successful that a similar job was done on another Lynn condenser containing 2,700 tubes.

Of course Revere wants to sell condenser tubes, and its other products in copper and copper-base alloys, and aluminum, but we know that fast friends and loyal customers are won by taking to heart the best interests of those with whom we deal. May we have the privilege of working with you on condenser tube matters? Send for free booklet, "Life Extension for Condenser Tubes."

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere

SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

New Construction

Proposed Work

Ala., Tuscaloosa—Reichold Chemicals, Inc., Tuscaloosa, plans to construct additions to its plant. Estimated cost $1,500,000

Ark., Batesville—Westmoreland Manganese Co., Batesville, plans to construct a processing plant here. Estimated cost $4,000,000

Fla., Foley—Buckeye Cellulose Corp., subsidiary of Procter & Gamble Co., Cincinnati, O., plans to construct a pulp plant here. Estimated cost $20,000,000

Kan., McPherson—National Cooperative Refinery Assn., McPherson, plans to construct a coking unit. Estimated cost $2,000,000

La., Baton Rouge—Esso Standard Oil Co., Baton Rouge, plans to construct new refinery distillation units, also expand fluid catalytic cracking facilities. Estimated cost $7,000,000 and $9,000,000 respectively

Me., Millinocket—Great Northern Paper Co., Manly C. McDonald, Pres., Millinocket, plans to construct a kraft mill. Estimated cost $6,000,000

Mont., Superior—Diamond Match Co., Superior, plans to construct a match factory, lumber mill and sawmill. Estimated cost $4,500,000

Okla., Ardmore—Ben Franklin Oil Co., Ardmore, plans to reconstruct a portion of its refinery. Estimated cost $450,000

Tenn., Columbia—Union Carbide & Carbon Corp., Columbia, plans to construct additions to its plant. Estimated cost $2,500,000

Tex., Freeport—Dow Chemical Co., Freeport, plans to construct a research laboratory to consist of eight buildings. Howard & Johnson, Scanlon Bldg., Houston, Engrs. Estimated cost $2,600,000

Tex., Harty—Southland Paper Mills, Inc., Harty, plans to construct a new mill. Estimated cost $15,050,000

Tex., Houston—Humble Oil & Refining Co., Humble Bldg., plans to construct a 2 story research laboratory. Estimated cost $2,800,000

Tex., Houston—San Jacinto Chemical Corp., c/o San Jacinto Ordnance Dept., plans to construct a plant to recover 11,500 additional tons of nitrogen yearly. Estimated cost $900,000

Wyo., Manderson—General Petroleum Corp., 108 West 2nd St., Los Angeles, Calif., plans to construct a natural gas plant, sulphur extraction plant and gathering lines. Estimated cost $2,750,000, $750,000 and $450,000 respectively.

Contracts Awarded

Calif., Los Angeles—Abbott Laboratories, 2850 East 40th St., have awarded the contract for a laboratory to Wm. P. Neil Co., 4814 Loma Vista Ave., at $122,000

	Current Projects		Cumulative 1952	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$6,000,000	$182,000	$6,000,000	$1,882,000
Middle Atlantic	.....	.....	33,350,000	7,312,000
South	40,000,000	36,716,000	193,865,000	82,111,000
Middle West	.....	10,000,000	17,900,000	68,859,000
West of Mississippi	36,250,000	20,422,000	361,923,000	182,652,000
Far West	.....	2,836,000	6,319,000	11,819,000
Canada	.....	.....	104,625,000	17,400,000
Total	$82,250,000	$70,156,000	$723,982,000	$306,735,000

Calif., Los Angeles—Wilcox Plastics, Inc., 971 Goodrich Blvd., will construct a 150x 280 ft. manfacturing plant. Work will be done by owner. Estimated cost $110,000

Calif., Wilmington—Union Oil Co., Wilmington, has awarded the contract for 17 gasoline refinery units to C. F. Braun & Co., 1000 South Fremont St., Alhambra, at $104,350

Ga., Albany—Merck & Co., Inc., Rahway, N. J., will construct a plant addition here with own forces. Estimated cost will exceed $100,000

Ky., Harrodsburg—Corning Glass Works, 1946 Crystal St., Corning, N. Y., have awarded the contract for two plants here for the manufacture of optical glass to Ditmars-Dickmann & Pickens Construction Co., 3712 W. Okmulgee Ave., Okmulgee, Okla. Estimated cost $2,116,000

La., Lake Charles—Davison Chemical Corp., Davison Chemical Bldg., Baltimore, Md., has awarded the contract for a catalyst cracking plant to Consolidated Engineering Co., Inc., 20 East Franklin St., Baltimore. Estimated cost $17,000,000

La., New Orleans—Freeport Sulphur Co., Freeport, Tex., will develop sulphur mining plants at Garden Island Bay Dome near mouth of Mississippi River and Bay Saint Elaine Dome, here. Work will be done with own forces. Estimated cost $7,500,000 and $6,750,000 respectively

Me., Madawaska—Frazer Paper Co., Ltd., Madawaska, has awarded the contract for power plant extension to Consolidated Constructors, Inc., 807 Congress St., Portland. Estimated cost will exceed $100,000

Mass., Springfield—Monsanto Chemical Co., 812 Monsanto Ave., has awarded the contract for addition to Mfg. Bldg. 85B and Warehouse Bldg., 85C to Beaudry Construction Co., 142 Hancock St., Springfield.

Miss., Belzoni—Belzoni Oil Works c/o Irby Turner, Belzoni, will rebuild its mill with own forces. Estimated cost $250,000

O., Painesville—Diamond Alkali Co., Union Commerce Bldg., Cleveland, has awarded contract to design and construct addition to plant for manufacture of chlorine to H. K. Ferguson Co., 1783 East 11th St., Cleveland. Estimated cost $10,000,000

Okla., Blackwell—Cities Service Oil Co., Bartlesville, will construct a 200,000 gal. per day natural gas plant and 12 mi. of products pipe line. Work will be done by purchase and hire. Estimated cost $300,000

Okla., Oklahoma City—Oklahoma Fertilizer Co., Oklahoma City, will construct a new fertilizer plant. Work will be done by purchase and hire. Estimated cost $300,000

Tenn., Columbia—Shea Chemical Co., Columbia, has awarded the contract for a plant to manufacture di-calcium phosphate to M. W. White Construction Co., Columbia. Estimated cost $3,000,000

Tex., Corpus Christi—Sunray Oil Corp., Jones Bldg., has awarded contract to design and construct aviation fuels catalytic cracking refinery to The Lummus Co., 385 Madison Ave., New York, N. Y. Estimated cost $5,500,000

Tex., Crane—Phillips Chemical Co., Bartlesville, Okla., will construct an additional sulphur recovery plant unit with own forces. Estimated cost $1,360,000

Tex., Freeport—Dow Chemical Co., Freeport, will alter its chlorine plant using own forces. Estimated cost $112,000

Tex., Houston—Eastern States Chemical Corp., Box 5008, subsidiary of Eastern States Petroleum Co., Inc., has awarded the contract for a benzine plant to Brown & Root, Inc., Box 3, Houston. Estimated cost $2,225,000

Tex., Houston—Eastern States Petroleum Co., Inc., Ship Channel, will rehabilitate and reactivate HF alkylation refining unit, refinery and Udex unit and expand fluid catalytic cracking unit. Work will be done with purchase and hire. Estimated cost $3,750,000

Tex., Liberty—Texas Gulf Sulphur Co., Liberty, will construct a sulphur mining plant with own forces. Estimated cost $1,750,000

Tex., McCamey—Texas Gas Products Corp., McCamey, will construct an addition to its natural gas plant. Work will be done by owners. Estimated cost $375,000

Tex., Needville—Freeport Sulphur Co., Freeport, will construct a sulphur mining plant. Work will be done with own forces. Estimated cost $1,750,000

Tex., Texas City—Texas City Chemicals, Inc., Texas City, has awarded the contract for a new unit to Chemical Construction Co., 488 Madison Ave., New York, N. Y. Estimated cost $3,000,000

Utah, Garfield—Garfield Chemical & Manufacturing Corp., joint subsidiary of American Smelting & Refining Co. and Kennecott Copper Corp., Pacific Natl. Life Bldg., Salt Lake City, has awarded the contract for a sulphuric acid plant to Leonard Construction Co., 37 South Wabash Ave., Chicago, Ill. Estimated cost $2,500,000

FLOWLINE

TRADE MARK

CORROSION-RESISTANT WELDING FITTINGS

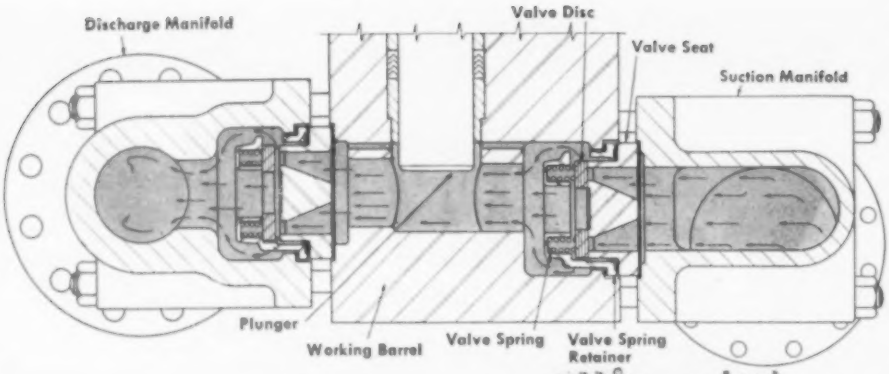
Reducers, stub ends, and caps are standard items of FLOWLINE corrosion-resistant pipe welding fittings. They are formed cold, seamless, by our exclusive process that puts the metal in the best condition for corrosion resistance. These fittings are made and normally stocked in various schedules—in sizes ½″ through 12″—in Stainless Steel Types 304, 316, and 347; Monel, Nickel, and Inconel. Other corrosion-resistant metals can also be supplied.

During the national defense program we are cooperating with other manufacturers by producing special shapes in corrosion-resistant metals. The sections of cylindrical shapes shown on the background are representative. In many instances available dies can be used. Our specialized production facilities include equipment for cold forming, annealing, cleaning, and passivating. Size limits—length 24″ max., diameter 24″ max.; wall thickness—1/16″ through ⅝″.

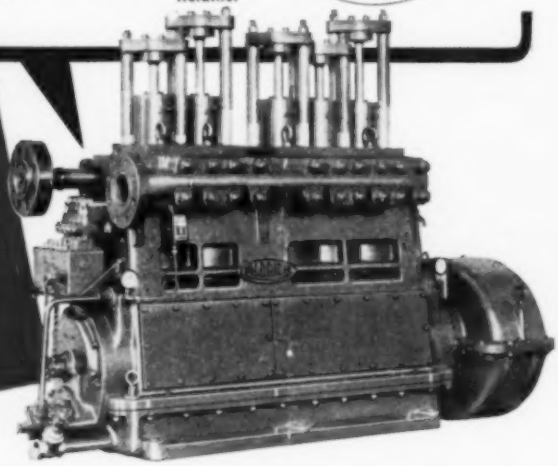
WELDING FITTINGS CORP.

NEW CASTLE, PENNSYLVANIA

World's Largest Manufacturer of Stainless Welding Fittings



ENGINEERS: Check these points of Aldrich Direct Flow Design



Aldrich engineers eliminated two right-angle turns in the fluid-end. Now, liquid passes from suction to discharge manifold in a *straight line.* That gave the Direct Flow Pump its name, and set up a whole new concept of pumps, pumping, and pump maintenance. It all adds up as follows:

☐ **Increased operating speeds**—you get whatever volume and pressure you need *from a smaller, lighter, more compact pump.*

☐ **Sectionalized construction**—parts can be replaced at a fraction of the cost of a new fluid-end; also, parts can be made of stainless, bronze, Monel or other special materials—extremely important for corrosive fluid service.

☐ **Maintenance made easier**—no more tapered bores in the working barrel. Manifolds are *not* taken off but slide out on studs—affording room to *lift out* valves as complete units. Packing is easily renewed—note accessibility of stuffing boxes.

☐ **Interchangeable wearing parts**—available among 3, 5, 7 and 9 plunger pumps of same stroke size. This minimizes spare parts costs and inventories.

☐ **Changeable plunger sizes**—in many cases it is only necessary to add new plungers, glands, throat bushings and packing *to the same fluid-end.*

☐ **Drive direct**—by connection to synchronous engine type motor or internal combustion engine; also with integral speed reducer or V-belts.

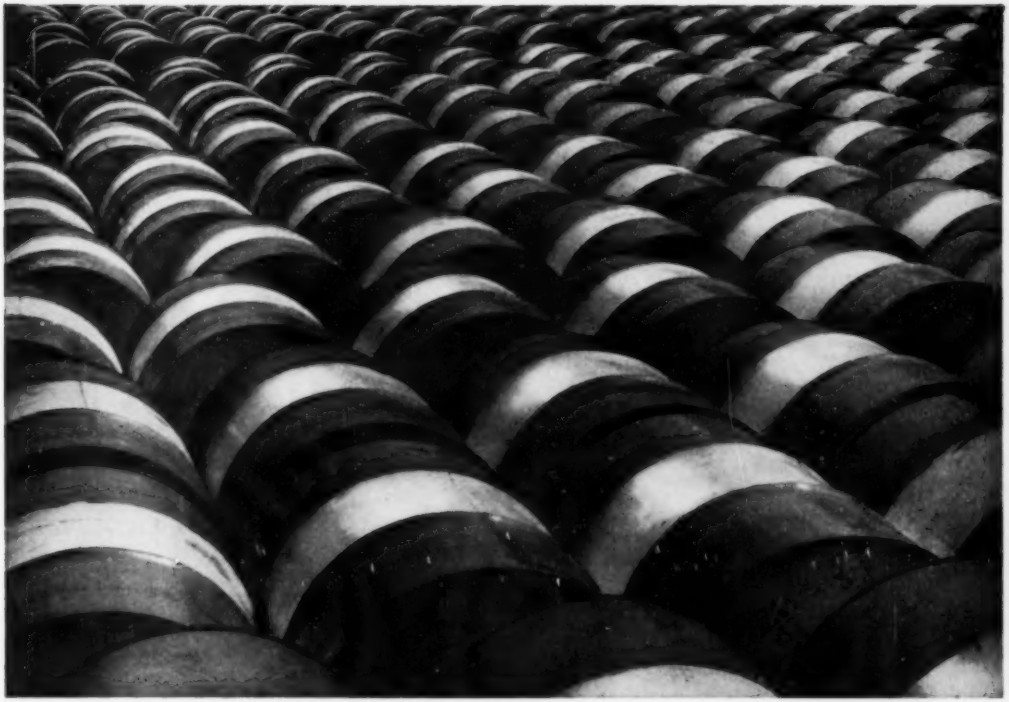
Contact your Aldrich Representative . . . or write to us direct for complete details on 3", 5" or 6" stroke units.

THE ALDRICH PUMP COMPANY

3 GORDON STREET • ALLENTOWN, PENNSYLVANIA

...Originators of the Direct Flow Pump

Representatives: Birmingham • Bolivar, N. Y. • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit
Duluth • Houston • Jacksonville • Los Angeles • New York • Omaha • Philadelphia • Pittsburgh • Portland, Ore.
Richmond, Va. • St. Louis • San Francisco • Seattle • Spokane, Wash. • Syracuse • Tulsa • Export Dept.: 751 Drexel Building, Phila. 6, Pa.



A cool 7800 barrels a day!

Cit-Con Oil Corporation's Lake Charles, La., plant is the largest in the world built exclusively for manufacturing of lube oil. Though rated capacity is 6000 barrels per day, it is actually running at 7800 bpd!

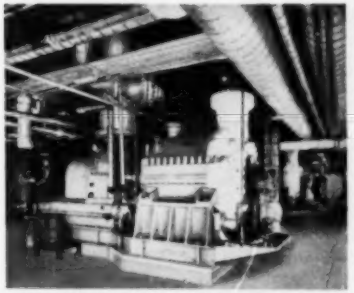
To produce this low pour point oil, Cit-Con uses two MEK dewaxing units equipped with 1165-ton Worthington Centrifugal Propane Compressors, with a standby compressor of the same capacity. The installation also includes 14 Worthington double pipe exchangers, 12 inclined direct expansion chillers, and 6 vacuum pumps.

Cit-Con is one of a large number of "big names" that have selected Worthington refrigeration. Others include: Esso Standard Oil Co., Bayonne, N. J., and Baton Rouge, La.; E. I. DuPont de Nemours & Co., Edgemore, Del., Orange, Tex.; Shell Chemical Corporation, Houston, Tex.; Socony-Vacuum Oil Co. Inc., Paulsboro, N. J., The Pure Oil Co., Smith's Bluff, Tex.; Standard Oil Co., Richmond Cal.; Sinclair Refining Co., Houston, Tex.; Tidewater Oil Co., Bayonne, N. J.

Important companies with world-wide reputations like these don't install *any* equipment on a haphazard basis. The fact that they've chosen Worthington refrigeration equipment is the best testimony we have for the conclusion: *there's more worth in Worthington.*

No other manufacturer makes so complete a line. And a Worthington system is Worthington-*made*—not just Worthington-assembled, assuring you of perfectly balanced operation and unit responsibility.

Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J.



WORTHINGTON CENTRIFUGAL PROPANE COMPRESSORS at Cit-Con Oil Corporation's Lake Charles, La., plant. Engineer and Contractor: The Lummus Co., New York, N. Y.

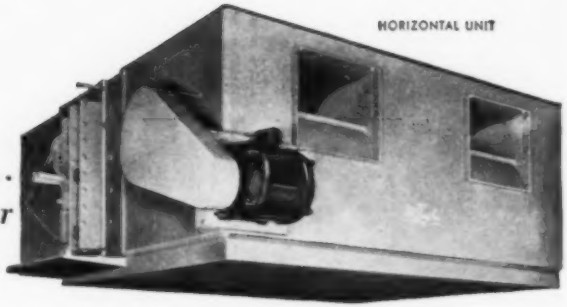
A.1.44

WORTHINGTON

Air Conditioning and Refrigeration

IN 8 MODELS

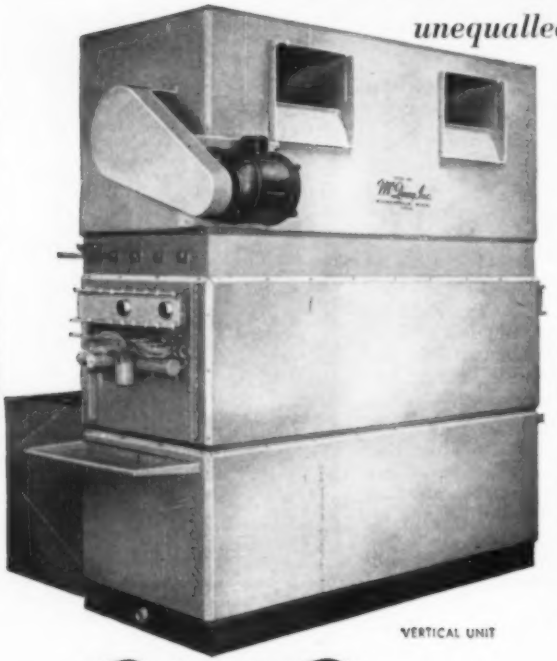
up to 65 tons cooling capacity...15,675 Cfm... 2,200,000 Btu per hour heating capacity



HORIZONTAL UNIT

McQuay CENTRAL STATION AIR CONDITIONERS

...with **RIPPLE-FIN** *construction to give you unequalled heat transfer efficiency!*



VERTICAL UNIT

Both the horizontal and vertical Central Station Air Conditioners provide year 'round comfort with cooling and dehumidification, heating and humidification, positive ventilation, and air filtering.

Each of eight models are sectionally built to give complete flexibility of arrangement and all parts are readily accessible to allow for ease of installation and service.

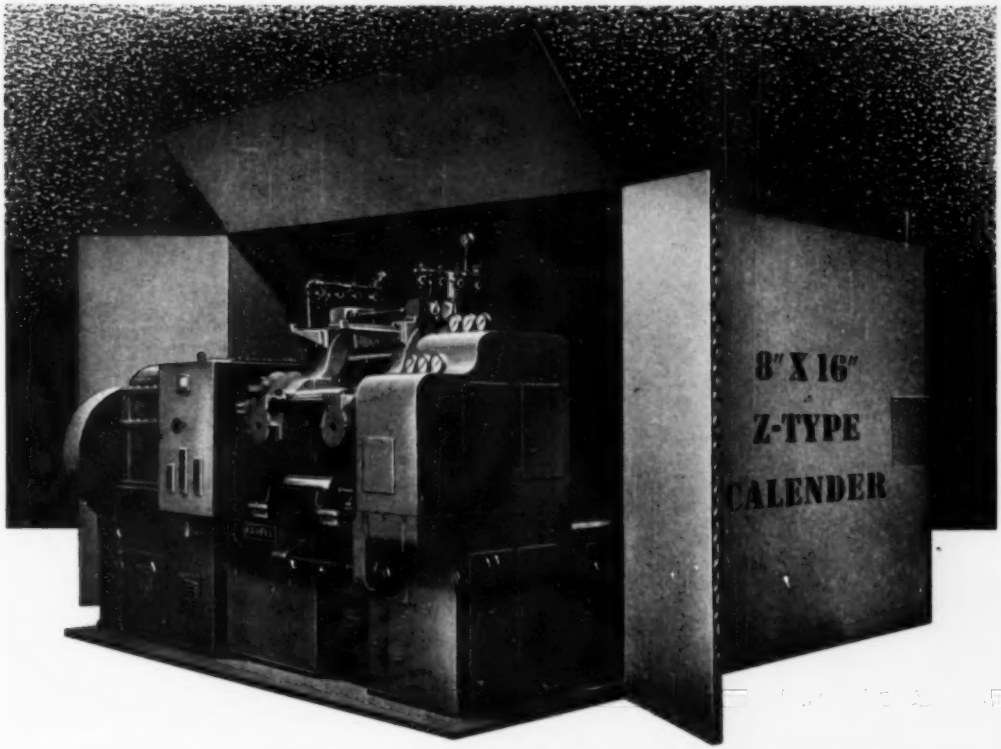
The famous McQuay Ripple-Fin Coils assure unmatched heat transfer efficiency. Also, because of the wide range of Cfm and Btu capacities offered, every normal heating and cooling application can be accurately met with McQuay Central Station Air Conditioners.

Auxiliary features available include: direct expansion, water, and steam coils, mixing box with dampers, "V" type and flat filter sections, humidifiers, and internal face and by-pass damper sections.

Representatives in principal cities. Write for Bulletin 502. McQuay, Inc., 1622 Broadway St. N. E., Minneapolis 13, Minnesota.

McQuay INC.

HEATING • REFRIGERATION • AIR CONDITIONING



HERE IS MAXIMUM CALENDER VERSATILITY IN A SINGLE PACKAGE

This 8" x 16" four-roll Z-type calender is probably the most highly versatile experimental machine of this type ever built. The drive arrangement permits flexibility in roll speeds and ratios for experimentation in single and double coating, sheeting, and running unsupported plastic film of very light gauges.

The drive motor furnishes adjustable speed for the four calender rolls, and a unique arrangement of gears and clutches provides variables in roll speeds one to another. This means that, by a simple movement of clutch levers, the rolls may be set at related speeds determined in advance to be most advantageous for the work to be done.

The rolls are bored and equipped with rotary joints for the circulation of temperature-controlling fluid. Gauge adjustment of all but the fixed lower roll is by hand ratchet. The use of clutches on the top roll and bottom side roll permits independent movement of roll ends or the simultaneous adjustment of both ends of either roll. In this manner roll openings can be set precisely for the most accurate production to gauge.

This unique calender is an example of the made-to-order laboratory equipment—calenders, Banburys, mills, extruders, refiners, etc.—which you can obtain from Farrel-Birmingham. Send for information on machines to meet your specific needs.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
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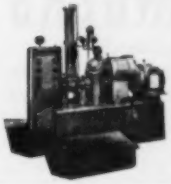
Farrel-Birmingham®

FB-730



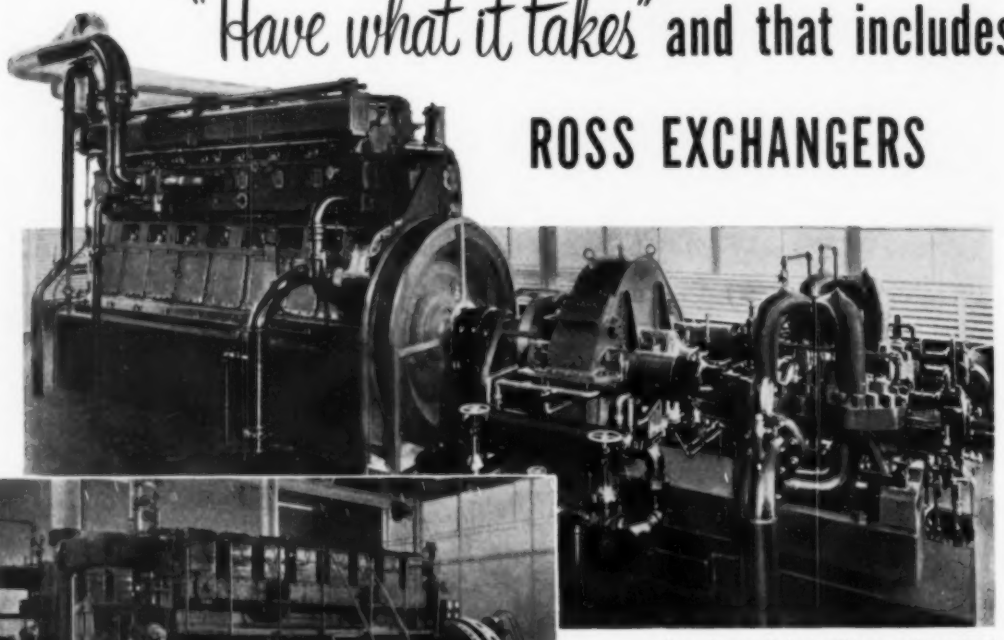
This size B Banbury mixer, with a capacity of two pounds of crude natural rubber or gravity of batch times 2, can be conveniently and economically used in making trial batches. It is driven by a four-speed motor and is equipped with an exceptionally large air cylinder for forcing stock into the mixing chamber.

The two rolls of this 6" x 13" self-contained laboratory mill are individually driven, providing a considerable range of operating speeds and friction ratios. Speed range of the back roll is 3 to 48.9 RPM and the front roll from 4.6 to 36.8 RPM. The mill has tiltable guides, scrapers, knee-operated safety trip and cascade lubrication.

work-proved Cooper-Bessemer engines

"Have what it takes" and that includes

ROSS EXCHANGERS



Cooper-Bessemer JS, 8-cyl., 600 hp gas engine, equipped with Ross Exchangers (not shown), direct-connected to Farrel-Birmingham speed increaser (also Ross Exchanger equipped) on a West Coast crude oil line.

Two Cooper-Bessemer JS, 8-cyl., 688 hp Diesel engines, equipped with Ross Exchangers, driving generators in a Michigan utility.

On oil or gas pipelines, in refineries or power generating plants, work-proved Cooper-Bessemer engines and compressors, in the words of their manufacturer, "have what it takes".

. . . and one of the very important things a Cooper-Bessemer Diesel or gas engine *must* have is efficient cooling. Lube oil and jacket water temperatures *must* be maintained at the correct level to assure the "Efficient Power at Lower Cost" which The Cooper-Bessemer Corporation promises.

That responsibility has largely been entrusted to Ross Exchangers. Performance-proved, pre-engineered, fully standardized . . . *they* "have what it takes", too, in the judgment of Cooper-Bessemer's design engineers and Cooper-Bessemer's customers alike.

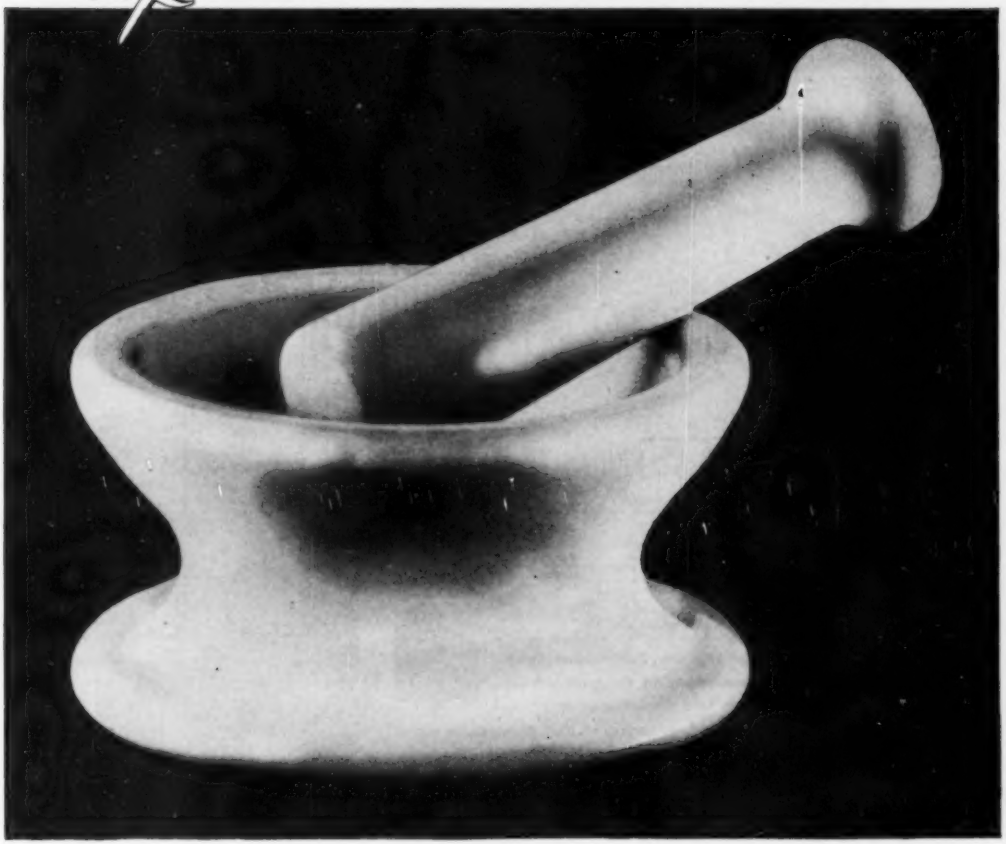
For meeting *any* heat transfer requirement, there is no better means than furnishing a standardized Ross Exchanger as original equipment. Details in Ross Bulletin 2.1K1. Write.

ROSS HEATER & MFG. CO., INC., Division of American Radiator and Standard Sanitary Corp., 1411 West Avenue, Buffalo 13, N. Y. In Canada, Horton Steel Works, Limited, Fort Erie, Ont.

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · ACME CABINETS · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

Rx: ALCOA ALUMINA FOR FINE GRINDINGS



Long the symbol of prescription druggists, the mortar and pestle represents fine grinding—and fine grinding calls for ALCOA Alumina.

It is no coincidence then, that Coors Porcelain Company, Golden, Colorado, chose ALCOA Alumina as the main component of their new mortar and pestle. Completely vitrified and non-porous, the alumina surfaces are extremely resistant to abrasion . . . unaffected by tungsten carbide scribers . . . only slightly scratched by diamond. ALCOA Alumina is especially suited to this product because its purity and hardness (9 on Moh's scale) permit extra fine grindings without fear of contamination.

ALCOA Alumina is aluminum oxide, a crystalline material with very sharp edges and corners. It is from this characteristic that alumina derives its value as an outstanding, fast-cutting abrasive.

ALCOA Alumina is only one of the versatile ALCOA Chemicals used throughout industry to make *better* products do a *better* job. Electrical insulators . . . high-temperature refractories . . . grinding balls . . . rubber . . . glass . . . are but a few of the hundreds of products which have been measurably improved by ALCOA Chemicals. Perhaps they can benefit *your* product. Write to: ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 602D Gulf Building, Pittsburgh 19, Pennsylvania.

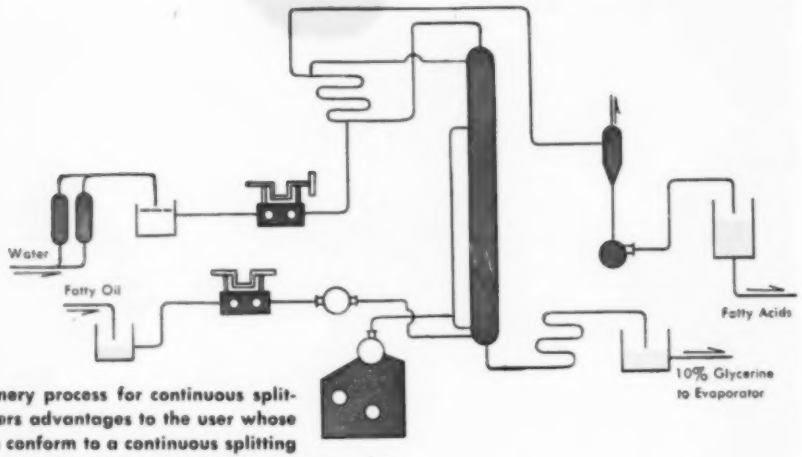
Alcoa Chemicals

ALUMINAS and FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • TABULAR ALUMINAS • LOW SODA ALUMINAS ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE • GALLIUM

Continuous fat splitting process

gives 98% split at lower cost



The Colgate-Emery process for continuous splitting of fats offers advantages to the user whose plant cycle can conform to a continuous splitting operation. Some of the advantages of this process as designed and constructed by Foster Wheeler Corporation are:

- **High degree of split without a catalyst, even higher with small amount of catalyst.**
- **Much less critical treatment of charging stock. With high grade fats an acid boil isn't needed – you just remove suspended impurities.**
- **Product's color is exceptionally light, even lighter than original fat when suitable bleach is used. Distillation is not necessary with high grade feed stocks for a good grade of fatty acid.**
- **Glycerine concentration of 13 to 18% in the sweet water with higher grade fats.**
- **Exceptional heat economy splits about five pounds of fat per pound of high pressure steam.**

Write for further information about this process.

All of the above advantages, plus ease of control and operation... uniformity of product... low labor cost... high throughput... low uniform steam and power consumption . . . small space requirements... and low interprocess inventory add up to lower splitting costs and increased plant capacity for you with Foster Wheeler continuous fat splitting equipment.

FOSTER WHEELER CORPORATION

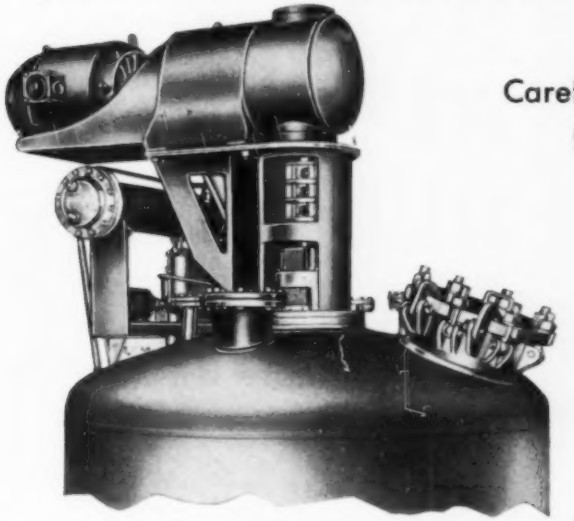
165 BROADWAY, NEW YORK 6, N. Y.

For Smooth Driving Action!

Easy Accessibility of Parts!

Long Trouble-Free Service!

Struthers Wells Processing Vessels

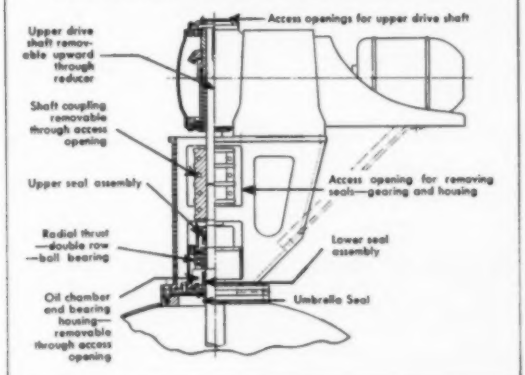


are equipped with Carefully Designed Agitator Drives for Extreme Temperature and Pressure Service

NOTE THESE FEATURES . . .

- ★ All parts are accessible for quick and easy removal and replacement.
- ★ Agitator Drive Shaft is radially supported at top and bottom of the drive providing a spread of bearings practically equal to the vertical space occupied by the drive.
- ★ Agitator Drive Shaft thrust is taken by radial-thrust double row ball bearing located in close proximity to pressure seals insuring accurate centering and a minimum end-wise motion of the shaft at locations of seals.
- ★ Seal parts are carbon and non-corrosive metals to withstand corrosion in the same degree as the metal used in the vessel.
- ★ Oil circulating unit provides equalized liquid pressure seal, which also lubricates and cools the working parts.
- ★ An umbrella seal is provided to accumulate seepage of oil across the seal face and eliminate contamination of vessel content.
- ★ Standard units are available for full vacuum or pressures up to 500 psi. with processing temperatures up to 650° F.
- ★ Made in five sizes—ranging from 1 to 50 horsepower.

Cross Sectional View Shows Accessibility of Parts


Access openings for upper drive shaft
Upper drive shaft removable upward through reducer
Shaft coupling removable through access opening
Upper seal assembly
Access opening for removing seals—gearing and housing
Radial thrust —double row —ball bearing
Lower seal assembly
Oil chamber and bearing housing—removable through access opening
Umbrella Seal

There is a dependable Struthers Wells Agitator Drive that will meet your exacting requirements. Write today for complete data on the size drive that will best suit your needs.

Struthers Wells

STRUTHERS WELLS CORPORATION

Process Equipment Department . . . Warren, Pa.

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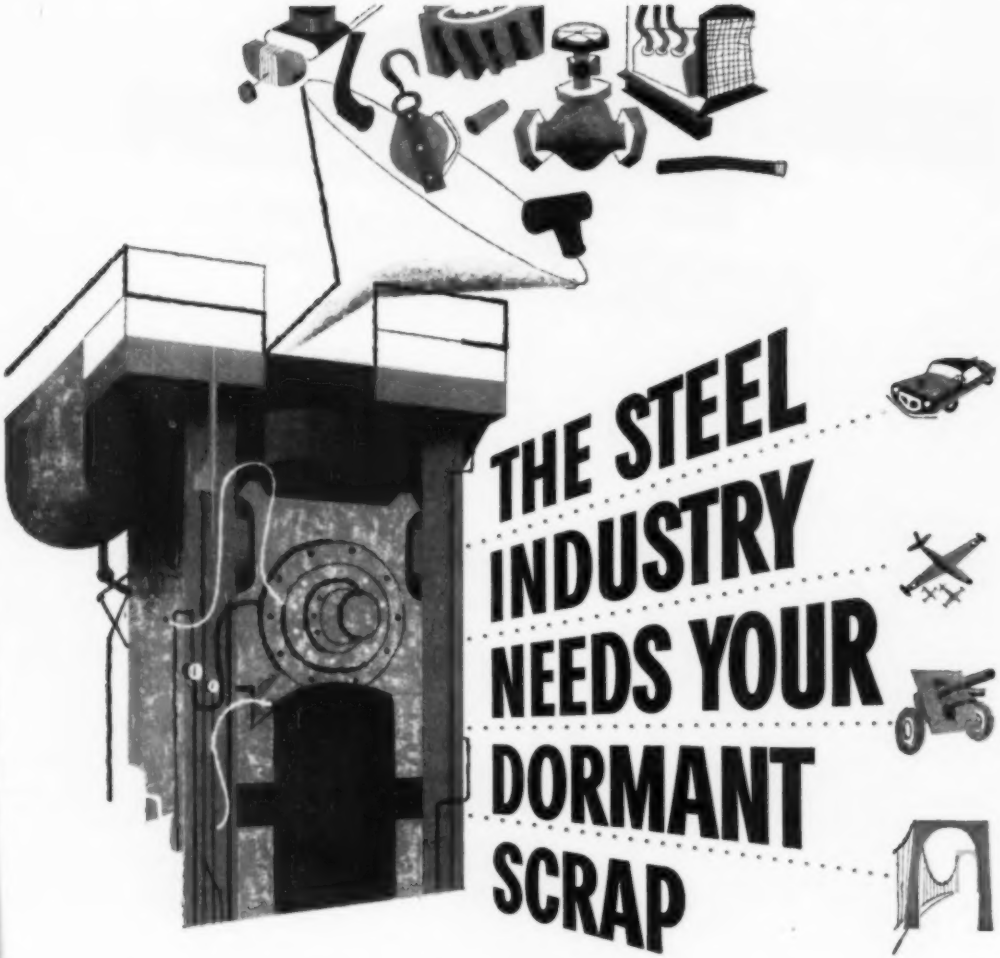


THE STEEL INDUSTRY NEEDS YOUR DORMANT SCRAP

Steel scrap is needed right now. Without it the steel industry can't produce the steels needed for *your* requirements. ***This is an emergency call. Dig up your dormant scrap.***

LOOK FOR OBSOLETE, DORMANT MACHINERY, TOOLS, JIGS, DIES, FIXTURES, OR ANY OTHER METAL EQUIPMENT, WHICH YOU NO LONGER NEED.

CRUCIBLE first name in special purpose steels

52 years of Fine steelmaking

CRUCIBLE STEEL COMPANY OF AMERICA GENERAL SALES AND OPERATING OFFICES, OLIVER BUILDING PITTSBURGH, PA.

Dependable Source For Chemical Raw Materials

Wyandotte Soda Ash is bagged and weighed on this fully automatic "merry-go-round."

Bulletin Board

***Kreelon*°:**
Wyandotte Kreelon, **recently improved**, has brought favorable comment from several fields . . . textile manufacturers note more rapid solubility; compounders like solubility and new foaming action. Ask for new booklet.

***New Pluronics*°:**
You'll want to look into this **first 100%-active flake nonionic ever commercially available.** Big news is the number of completely new products, in several fields, now in testing stage . . . **based on Pluronics.** Samples and literature available.

Chlorine:
Already an important supplier of chlorine to the chemical industries, Wyandotte is currently expanding its chlorine facilities to supply growing requirements. Consult us about your future needs.

Caustic:
Regardless of the quality of caustic your process requires, Wyandotte has a grade that will satisfy your needs . . . Mercury Cell Caustic, our finest, is reagent quality. Samples and quotations available upon request.

Purecal*° in rubber:
Experiments in Purecal in GR-S stocks have resulted in a method of making superior white sidewalls **without natural rubber!** Write for details.

Wyandotte Soda Ash: The supply is reliable!

In periods of long or short supply, Wyandotte has the reputation — *and the means* — of taking care of its customers. Here's why it pays to rely on Wyandotte:

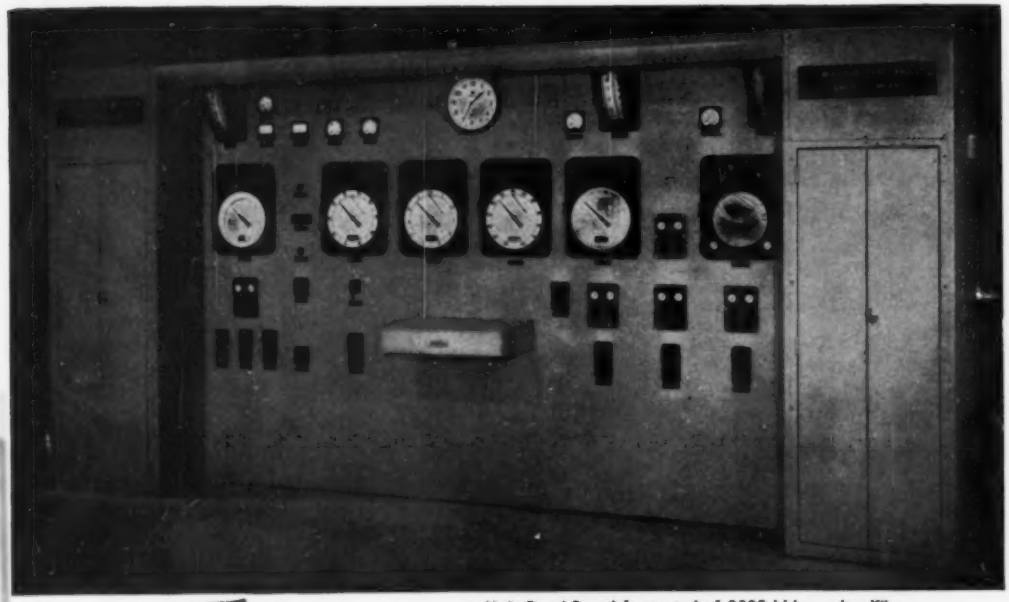
Salt wells, limestone quarries, and coal mines, *owned and operated by Wyandotte*, assure adequate raw materials.

Central location of resources and manufacturing facilities on one of the world's great waterways, on major railroads, and several major truck lines, assures the supply's reaching *you*.

Current expansion of soda ash production facilities means that the supply — adequate now — will be still more able to meet your needs in the future.

This holds for other chemicals you're interested in, too: read the "Bulletin Board" for up-to-the-minute facts on them. And for further information, write — *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in Principal Cities.* °TRADEMARK

Wyandotte CHEMICALS



Main Panel Board for control of 3000 bbl per day Kiln at Missouri Portland Cement Company, St. Louis, Missouri.

3 Ways Better

...Bailey Control for Rotary Kilns

Bailey Control for Rotary Kilns gives you better performance three ways:

1. Economical Operation
2. Uniform Quality of Product
3. Reduced Maintenance

These are advantages which can be achieved when all phases of kiln operation are coordinated to work together as a team. Here's how Bailey Kiln Control can help you get all three.

ECONOMICAL OPERATION

With Bailey Combustion Control you can be certain that you are getting maximum product for every unit of fuel you burn. Bailey Control closely guards the Fuel-Air Ratio, Hood Draft, Fuel Feed, Clinker Cooling and the Temperature of Air for Combustion.

UNIFORM QUALITY OF PRODUCT

Bailey Instruments and Controls can help you achieve a uniform high grade product. Measurements of temperatures, kiln speed, combustibles content, and oxygen content can be transmitted to recorders on centrally located control boards like the one shown. There is no sacrifice of accuracy or speed of response. High temperature alarm contacts may also be provided with Bailey Pyrometers as a further aid in achieving optimum uniformity of product.

REDUCED MAINTENANCE

By maintaining uniform temperatures and excess air conditions in the kiln, Bailey Controls help to reduce to a minimum costly refractory repairs and wear and tear on auxiliary equipment.

Bailey Meter Company has a staff of engineers who are experts in the control of rotary kilns. Assure yourself of optimum kiln performance. Let one of these men help plan your Kiln Control System. P-22

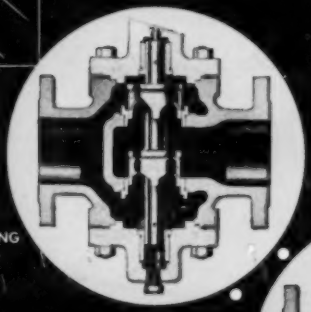
BAILEY METER COMPANY

1054 IVANHOE ROAD • • • CLEVELAND 10, OHIO

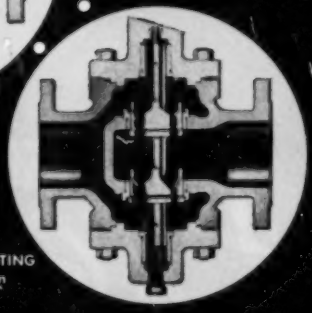
Controls for Processing

TEMPERATURE · PRESSURE · % OXYGEN · % COMBUSTION · FLOW · LEVEL · DENSITY · RATIO

QUICK SHIFT

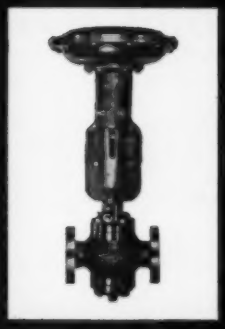


DIRECT ACTING
air to close



REVERSE ACTING
air to open

for easy field reversal of valve action



You can reverse the control action of the Honeywell Series 700 Valve by inverting the valve body and disc, and turning the travel indicator plate to its reverse side. It can be done in the field . . . easily and quickly, without extra parts or complex adjustments.
The Honeywell Series 700 wide band proportional control valve comes in a full range of styles and sizes . . . has *all* the features you look for in a fine valve.
Write today for your copy of Bulletin 700-2.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division,* 1904 Windrim Avenue, Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
VALVE PRODUCTS

H
HONEYWELL

First in Controls

For over a quarter of a century, Harriet Hubbard Ayer's Hand Cream has been a perennial favorite with American women . . . and Glycerine has been a favorite ingredient with the manufacturer. Its efficacy as a component of beauty preparations is amply proven by the acceptance shown for Glycerine by cosmetic leaders like Harriet Hubbard Ayer today.

FULLY ACCEPTED . . . FULLY AVAILABLE IN ALL GRADES!

Harriet Hubbard Ayer—and a score of other cream and lotion manufacturers—depend on U.S.P. Glycerine to protect feminine hands . . . without leaving a sticky residue on the skin.

Indeed, U.S.P. Glycerine is the common ingredient among hundreds of toiletries and cosmetic preparations that are favorites of the American consumer. A plasticizer in toothpastes and cake-type powders . . . a "bodying" and spreading agent in face creams—Glycerine can be found in almost every item on wash stand or dressing table!

No single substitute can bring all of Glycerine's properties to the production of toilet goods—plus the assurance of physiological safety. That's one reason why formulas developed years ago—as well as scores of new preparations—include this time-tested ingredient. The scope of Glycerine's applications is reviewed in our booklet, "Why Glycerine for Drugs and Cosmetics?" A copy is yours for the asking.

GLYCERINE PRODUCERS' ASSOCIATION
295 Madison Avenue, New York 17, N. Y.

LADISH

Controlled Quality

PIPE FITTINGS

reduce piping assembly time

Makeup goes smoother... with less chance for delay... on those piping systems where Ladish fittings are installed. Ladish Controlled Quality makes the difference. By exacting controls over materials and manufacturing processes... Controlled Quality assures uniform weldability through metallurgical integrity, fast assembly through dimensional accuracy and provides a real assurance of ultimate operating economy and complete dependability... reasons why it pays to specify LADISH.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

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District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
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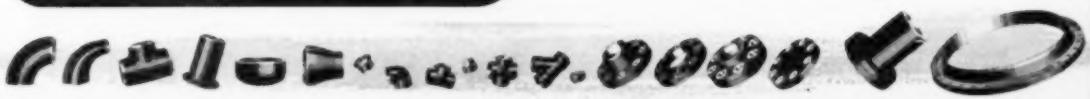
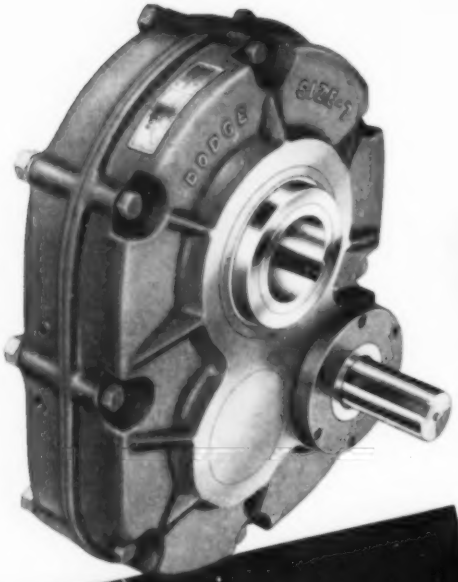




A NEW SIZE!

43 H.P.

DODGE TORQUE-ARM

The Speed Reducer that saves you real money!

Here it is—the big size that enthusiastic Torque-Arm users have been asking for! Engineered for the same dependable performance and same economy that have made Dodge Torque-Arm Speed Reducers a nation-wide sensation.

- The new "big brother" of the famous Torque-Arm family. Double reduction. 43 hp capacity. Output speeds from 12 to 110 rpm.
- Rugged. Dependable. *Economical.* No special engineering required. No foundation to provide. No flexible couplings. No "lining up" difficulties. No expensive installation.
- Stock TAPER-LOCK sheaves prescribed for each job provide desired speeds. Applications to other machines is practical and easy.
- Unit is driven through any V-belt drive. A torque arm, fastened to any fixed object, anchors the reducer unit. Turnbuckle provides fast and accurate adjustment of belt tension.
- Backstop available from stock when required. Easily installed. Sealed and lubricated inside reducer housing.
- Dodge Tri-Matic Overload Release, which provides positive protection for driven machines both mechanically and electrically, is available from stock.
- Dodge Torque-Arm Speed Reducers are built in two series—Single and Double Reduction. Eleven sizes in all, with capacities from 1 to 43 hp and output speeds from 13 to 333 rpm. All available from distributors' stocks.
- WRITE for special Torque-Arm bulletin.

DODGE MANUFACTURING CORPORATION
200 Union Street • Mishawaka, Indiana

DODGE

of Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new cost-saving methods. Look for his name under "Power Transmission Equipment" in your classified phone book.

SEALED-LIFE V-BELTS AND TAPER-LOCK SHEAVES

DODGE-TIMKEN PILLOW BLOCKS

SOLID STEEL CONVEYOR PULLEYS

NAME PLATES

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY,
CHICAGO THRIFT-ETCHING CORPORATION, 1555 SHEFFIELD AVENUE, CHICAGO 22, ILLINOIS

DRY FEED

LIQUID FEED

SYNCHRONIZED

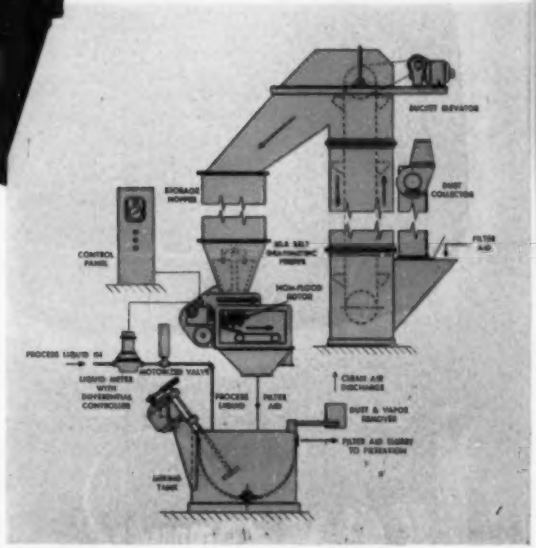
Automatic System

FOR **CONTINUOUS** PREPARATION OF FILTER AID SLURRY

Filtration — an increasingly important operation in the food, petroleum, pharmaceutical, and chemical industries — is put on a mechanized basis with this "packaged" system for preparing filter aid slurry . . . one of the many Omega Feeding and Proportioning Systems available to industry today.

This system feeds finely pulverized filter aid (weighing 7 to 15 lbs. per cu. ft.) in step with the flow of process liquid to the filters. A sensitive synchronizing unit maintains the pre-selected ratio of dry material to liquid . . . keeps slurry concentration at the optimum level . . . eliminates hit-or-miss, high-cost manual preparation. It's an Omega System throughout — from the Model 50-8 Belt Gravimetric Feeder (accurate within ± 1% by weight) to the mixing tank, dust and vapor removal devices, synchronizing mechanism, and control panel. The design and construction of this "packaged" system is 100% an Omega responsibility which relieves the customer of the purchasing and engineering of individual components.

Omega Dry and Liquid Feeders fit into the widest range of continuous processing and blending operations. Tell us about your problems and we will gladly submit recommendations and quotations. Omega Machine Company (Division of Builders Iron Foundry), 369 Harris Ave., Providence 1, Rhode Island.



Continuous slurry preparation system including Omega 50-8 Belt Gravimetric Feeder with positive, non-flood feeding mechanism; mixing tank and agitators; dust collector, bucket elevator, storage hopper; control panel and differential controller.

BH INDUSTRIES

OMEGA

THE LAST WORD IN FEEDERS

OMEGA

Omega manufactures a complete line of volumetric and gravimetric feeders for dry materials and for gravity feeding of liquids and solutions.

revolutionary new KEY-KAST alloy welding fittings assure longer life for piping systems!

1. Greater wall thickness throughout—for increased structural strength.

2. Extra thickness in critical areas —for greater allowance against corrosion and erosion.

Check these KEY-KAST features against YOUR alloy welding fitting needs!

Produced in all shapes . . . sizes . . schedules.

Available in low and intermediate alloys and various stainless steels.

Bosses provided on all fittings for tapped openings.

Controlled quality . . . through rigid metallurgical control. Produced, inspected and tested in one plant.

Lower unit cost.

Meets A.S.M.E., A.S.T.M., and A.S.A. codes

PROMPT DELIVERIES! Wire or write for information today.

GET THE FACTS! Send for your copy of the Key Kast Welding Fitting Bulletin (Please make request on your letterhead).

key company

Since 1916 . . . manufacturers and developers of products for high temperatures and pressures

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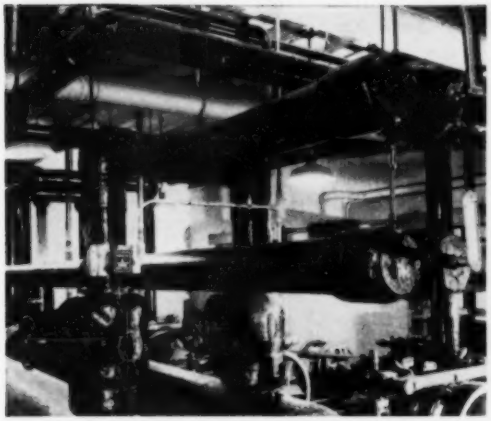
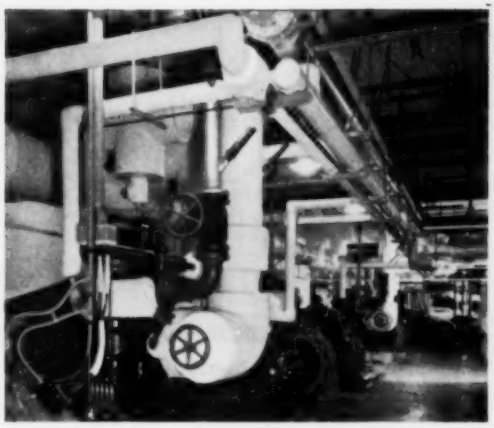


Cold line painted with Cork Covering Paint has neat, shiny black finish.



Sewed canvas provides de luxe finish and can be painted any desired color.

We have been asked . . .

"What's the best finish for cork insulated cold lines?"

A letter we recently received from a hotel engineer presented the following problem: "We are running some refrigeration lines in connection with the air conditioning of our dining rooms and wonder what would be the best finish for the cork covering on these lines."

Here's how we answered him: The proper finish for cork covering should be determined by two things—the conditions surrounding the lines and the desired appearance of the installation.

Where piping runs through dry rooms, the recommended finish for most installations is Armstrong's Cork Covering Paint. This brushed-on asphaltic paint provides a neat, shiny black finish for the line and also reinforces the vapor resistance of the factory-applied asphalt mastic finish on the cork covering.

For areas where a de luxe appearance is desired, the canvas finish is recommended. So that the finished job will be neat and smooth, a layer of rosin-sized paper is wrapped around the covering before 8-oz. canvas is neatly pasted or sewn in place. After the canvas is in place, it can be sized and then painted in any desired color.

Where piping runs through wet or humid atmospheres, refrigerated rooms, pipe shafts, or outdoors, roofing paper should be wired on straight pipe runs and painted with Armstrong's Cork Covering Paint. On fitting covers, Armstrong's Insulmastic, a weatherproof asphaltic compound, should be troweled on over hexagonal wire mesh.

In addition to these finishes, Armstrong can furnish special solvent-proof and fire-resistant finishes for cork pipe covering.

When you have any question about the selection or finishing of cold line insulation, consult the Armstrong engineer. He can furnish sound, practical advice on any insulation problem. The complete contracting organization he represents is equipped to handle any insulation job—offering qualified engineering aid, top-grade materials, and skilled application.

SEND US YOUR QUESTIONS: If you have any questions on the use or application of either high- or low-temperature insulation, please do not hesitate to write to us. We'll do our best to give you a prompt and practical answer. Just address a letter or post card to Armstrong Cork Company, 3304 Concord Street, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2800°F.

American Blower... a time-honored name in air handling

El Paso, Texas, has a conveniently located American Blower Office to provide you with data and equipment for air handling. You can reach American Blower in El Paso by calling 2-2646. In other cities, consult your phone book.

CLASSROOM COMFORT

Children in schools all over the country now learn their three R's in real classroom comfort, thanks to Nesbitt Syncretizers. For winter heating fresh air is drawn in from outside, warmed, and continuously circulated without drafts. Result . . . rooms are more pleasant, more inviting. Available with or without matching storage cabinets, Nesbitt Syncretizers are gracefully styled to complement any schoolroom.

HEAT WITH GAS?

If you heat with gas and your present heating system is inadequate or inefficient, replace or supplement it with American Blower Gas-Fired Unit Heaters. They're built for long, hard service, are finished to harmonize with modern interiors. A.G.A.-approved, American Blower Gas-Fired Unit Heaters are designed for either manufactured, mixed, natural or liquefied petroleum gases.

MORALE BUILDER

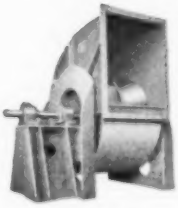
Good food and a pleasant atmosphere just naturally go together. Many firms, with employee cafeterias, use American Blower Utility Sets to keep kitchens and dining areas well ventilated. The Utility Set is ideal for general ventilation where duct systems are required. It can be used as a supply or exhaust fan and is equipped with Aileron Control for regulation of airflow. They're available as standard packaged units ready for immediate installation.

Whether your needs are civilian or military, American Blower heating, cooling, drying, air conditioning and air handling equipment improves over-all comfort and efficiency. For data, phone or write our nearest branch office.

Unit Heaters

Ventura Fans

Air Conditioning Equipment



Industrial Fans

Utility Sets

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary corporation

YOUR BEST BUY **AMERICAN BLOWER** AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

WYANDOTTE
CHEMICALS
Proper application of a chemical is almost as important as the chemical itself. You'll be glad to know that Wyandotte has a research staff whose job is to see that you get all the technical assistance you require.

Shoes courtesy Converse Rubber Company, Malden, Massachusetts.

Soles grip better, wear longer when YOU use Wyandotte PURECAL T

Formulate with PURECAL* T (using higher loadings than with carbon blacks). Get these desirable properties:

Kids give shoes an awful beating. "Cowboys-and-Indians" can grind shoes on hard concrete, test them on slippery roofs, tear them on sharp rocks.

The Problem: To build more safety, tear-resistance, and wear into rubber soles.

The Solution: Reformulation, using Wyandotte Purecal T, an ultrafine reinforcing filler. Same procedure was followed as processing carbon blacks. Purecal T is a *white carbon black* . . . with respect to particle size.

The Results: Soles with extreme flexibility; good grip on slippery surfaces; unusually long life.

For You: If you use a GR-S; some other synthetic elastomer with poor pure-gum properties . . . *you* can enjoy these improved properties, PLUS these production advantages:

Purecal T gives you building tack in an all GR-S stock . . . it promotes knitting.

Purecal T lessens "nerve," makes smoother stocks, extends GR-S.

Purecal T has high abrasion resistance for a calcium carbonate . . . approaches that of the best clays.

Purecal T is snow-white . . . non-discoloring.

Purecal T and carbon blacks in combination improve quality, lower hysteresis in GR-S passenger-tire stock, and impart sufficient building tack for tying in over beads without cementing. Purecals can help you! *Call Wyandotte 1700* or write direct to *Wyandotte Chemicals Corporation, Wyandotte, Michigan.*

*Trademark

Wyandotte CHEMICALS

*Overcured Sections — present every 30' to 40' in all belts made by the flat press method. Only Rotocuring (continuous, non-stop curing) eliminates this major cause of belt failures.

Here Lies a Good Conveyor Belt ...killed by OCS*

—BWH ROTOCURE prevents these fatalities — look for it in the belts you buy

Press overlaps, inherent in belts cured by flat press methods, are a primary cause of early belt failure. The overlaps result in overcured segments 2" to 4" wide across the entire belt because vulcanization is *not* continuous. These 2" to 4" segments are *double cured* — and *double curing weakens the structure!*

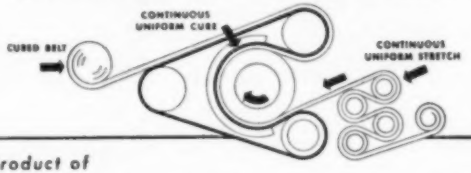
When you buy a BWH conveyor belt made by the *continuous* ROTOCURE process of vulcanization you obtain a *uniformly strong* belt *overall*. The weakened segments due to overlapping that sabotage operations and inflate belting costs are completely eliminated. With continuous, endless vulcanization you'll be ahead four ways:

1. In increased belt flex life — as much as 40%
2. In elimination of mechanical distortion at the press ends
3. In constant, uniform stretch
4. In uniform, abrasion-resistant covers

These characteristics of BWH Conveyor Belts mean minimum belt maintenance costs, longer belt life and appreciable per ton savings in the cost of what you convey! Ask your BWH distributor to show you how these highly serviceable belts can help you. Or write us direct.**

**Ask him also about BWH Rotocured Transmission Belts. Because they permit operation at lower tensions, you are assured of longest possible belt life.

DIAGRAMMATIC SKETCH OF EXCLUSIVE ROTOCURE PROCESS



BWH
DEPENDABLE RUGGEDNESS

Another Quality Product of

BOSTON WOVEN HOSE & RUBBER COMPANY

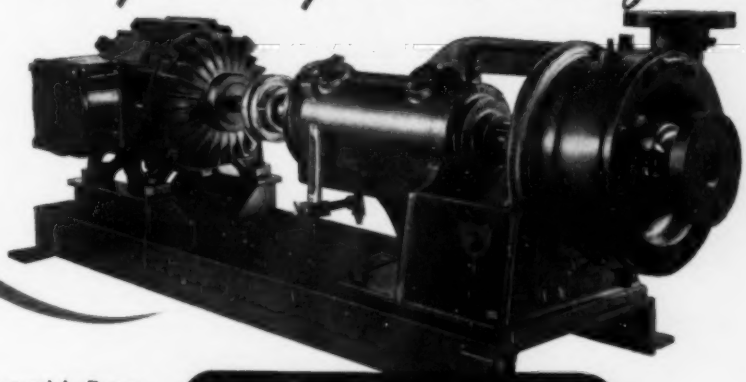
Distributors in all Principal Cities

PLANT: CAMBRIDGE, MASS. • P.O. BOX 1071, BOSTON 3, MASS., U. S. A.
WAREHOUSE STOCK, 111 NORTH CANAL ST., CHICAGO, ILLINOIS

WHY BUY MORE PUMP THAN YOU NEED?

this standard pump can be used on many special jobs—

may save you hundreds of dollars



ALLIS-CHALMERS

General Purpose

Chemical Pumps

HERE'S A TYPICAL CASE! An Eastern chemical company has standardized on Allis-Chalmers general purpose chemical pumps. They now handle chemicals up to 500 F with pumps costing hundreds of dollars less than the pumps they used formerly.

Allis-Chalmers general purpose pump isn't meant to do *every* job in the chemical industry. On the other hand, it can't be beat on many applications and costs much less than refinery type pumps widely used in the industry. It will handle a big percentage of chemical industry jobs, for several reasons:

- It's built in most used size range . . . to 1200 gpm, 250 ft head.
- Handles liquids in most common temperature range . . . up to 500 F.
- Built in wide choice of materials. Can be provided with six different sealing arrangements, including a water cooled stuffing box . . . somewhat unusual in a pump of this type.

Another feature is the large, easily changed reservoir of oil for lubricating the bearings. Pedestal is of rigid, corrosion resistant cast iron. As you can see from the picture, there is plenty of room between pump and pedestal for easy maintenance.

Allis-Chalmers can supply you with a complete pumping unit — pump, motor, drive, and control — all of coordinated design and manufacture and all mounted on a rigid base ready to install.

To get more information on Allis-Chalmers General Purpose Chemical Pumps, call your Allis-Chalmers Authorized Distributor or District Office. Or write Allis-Chalmers, Milwaukee 1, Wis., for Bulletin 52B7638.

A-3666

Sold . . .

Applied . . .

Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

Texrope and Vari-Pitch are Allis-Chalmers trademarks.

ALLIS-CHALMERS

OIL-FREE COMPRESSORS

VACUUM PUMPS and BOOSTERS

Right above: Five JOY WNO-112 Oil-Free Compressors for pressure-testing of food containers, oil-free ejection of metal stampings, paint spraying and general oil-free processing service.

Left foreground: Three JOY WGV-9 Vacuum Pumps handle the job of vacuum feeding of metal sheets.

Left background: These three JOY WGB-9's boost gas pressure for the burners in the soldering process.

WSD 1-4018

giving highly satisfactory service in a large Midwestern Can Factory

For dependable *oil-free* air, day in and day out—as you may need it for any chemical processing or other special operation, or on that exacting instrument control job—there's a JOY OIL-FREE Compressor to meet your particular requirements. Dual Cushion valves, surface-hardened wearing areas and replaceable wearing parts are some of the exclusive JOY design features, and there's a complete line from 163 to 8800 CFM at pressures up to 100 PSI. A complete line of standard Compressors, Vacuum Pumps and Booster Compressors, too, for many different needs. Write for complete information, or . . .

Consult a Joy Engineer

Over 100 Years of Engineering Leadership

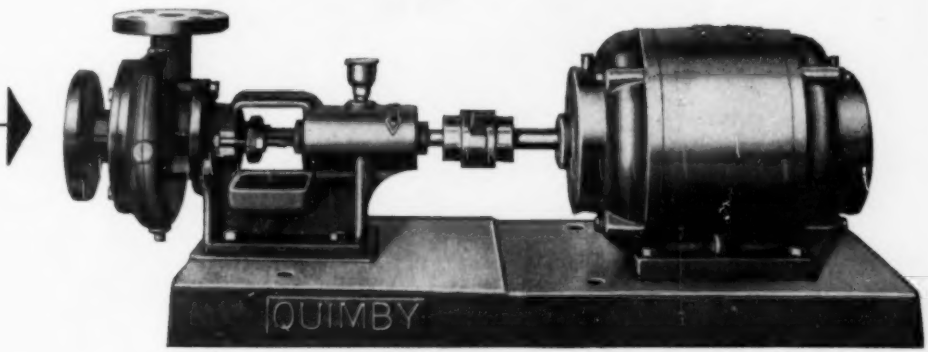
JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

dependability and economy are assured

with this Warren-Quimby Type "G" Pump



This Warren-Quimby Pump is designed to give both dependable and thoroughly economical satisfaction in process industries and chemical plants having semi-critical requirements. It has proven its merit conclusively whenever correctly applied.

Simplicity of design, sturdy bearings, extra deep stuffing box, tapped catchall, together with strong construction throughout the entire rigid assembly, all contribute to long, useful life at moderate cost.

It is available in 1, 1¼, 1½, 2 and 3 inch discharge sizes. Capacities up to 400 GPM—heads up to 240 feet.

WARREN QUIMBY PUMPS

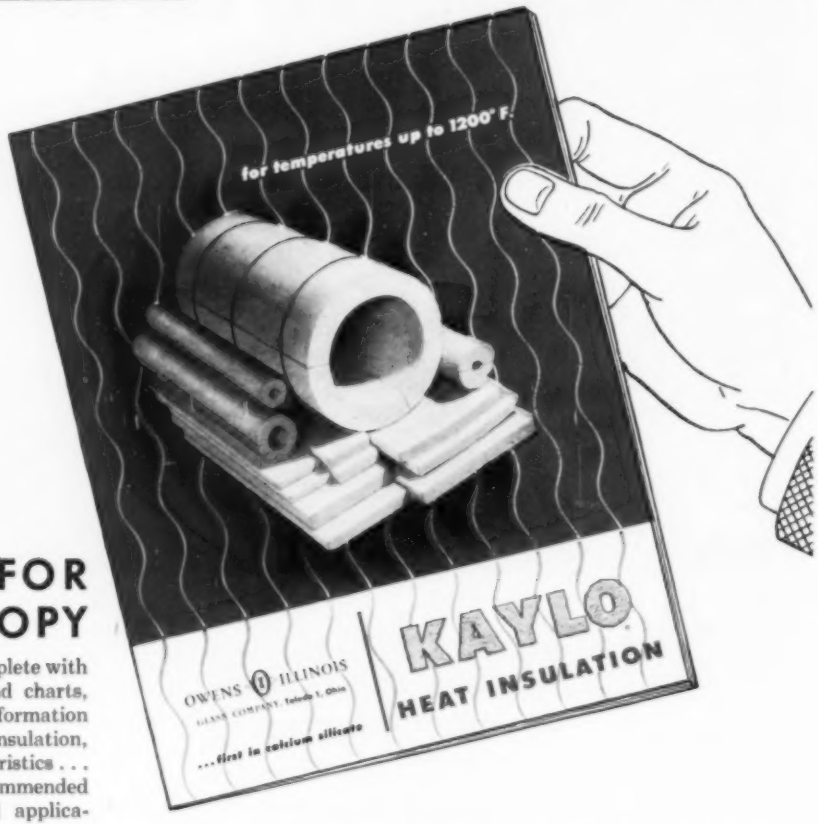
SEND FOR BULLETIN WQ-213 giving Specifications, Selection Chart, etc.

CQ-4

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC., WARREN, MASSACHUSETTS

Every User Can Profit of Heat Insulation From This New Book



WRITE FOR YOUR COPY

This useful book, replete with pictures, graphs and charts, contains specific information on Kaylo Heat Insulation, including characteristics . . . efficiencies . . . recommended thicknesses . . . and application data for pipes, vessels and flat surfaces. For your free copy of this book, write: Dept. N-258, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

Kaylo Heat Insulation is a hydrous calcium silicate—the heat-saving material that is revolutionizing insulation practice with its outstanding combination of advantages.

KAYLO® ... *first in calcium silicate*

...*pioneered by* OWENS ILLINOIS Glass Company

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BRIDGEPORT BRASS COMPANY
CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

PHYSICAL PROPERTIES OF COPPER AND RED BRASS TUBES

Although many copper alloys are available today for use in fresh water, copper itself is still most widely used in numerous types of heat exchangers, evaporators and condensers.

Copper is preferred to the yellow brasses because it does not contain zinc and hence is not subject to dezincification. It has the highest thermal conductivity of the common metals and is specified where this property is desirable. Since it does not become covered with an insulating layer of rust, the heat transfer properties are maintained in service.

Copper and copper alloys are not subject to embrittlement at low temperatures required in refrigerating and cooling operations. Copper and red brass are also resistant to the common organic refrigerants containing halogens such as Freon, etc. Copper is also satisfactory for handling dry sulphur dioxide but is not suitable for ammonia.

In ammonia refrigeration systems, copper (and red brass and other copper alloys) in combination with low carbon steel (Duplex Tubing) is fast replacing steel tubing. The fresh cooling water is handled on the copper side while ammonia comes in contact with the steel side. This combination of metals has the advantage of better heat transfer properties than steel tubing itself. Copper is less subject to fouling by algae and bacteria than steel. Where strength and corrosion resistance to flue gases are desired, Duplex Tubing with steel to the gases and copper towards the water side, is giving satisfactory results as compared with steel boiler tubes.

Copper is also widely used in low pressure feed water heaters and hot water heaters because of its good resistance to corrosion by steam, condensate, and water.

Arsenical copper is preferred where its service records indicate its superiority. In general the various grades of copper show essentially the same corrosion resistance.

Copper is widely used in sugar refining operations where traces of ammonia may lead to stress-corrosion cracking of the yellow brasses.

COMPARATIVE PHYSICAL AND MECHANICAL PROPERTIES OF DEOXIDIZED COPPER, ARSENICAL COPPER AND RED BRASS

	Deoxidized Copper 103	Arsenical Copper 108	Red Brass 85
ANALYSIS			
Copper	99.9	99.4	85.0
Zinc			15.0
Phosphorus	0.02	0.02	
Arsenic		0.3	
MECHANICAL PROPERTIES			
Tensile Strength—Hard Drawn	45,000	45,000	—
—Light Drawn	37,000	37,000	—
—Soft	30,000	30,000	40,000
Yield Strength—Hard Drawn	40,000	40,000	—
—Light Drawn	30,000	30,000	—
—Soft	8,000	8,000	12,000
Elongation % in 2" Hard	25	20	—
Soft		47	45
Contraction in Area % Hard		48	
Soft		62	76
Rockwell Hardness—Hard	F77	F77	—
—Soft	F40	F42	F71
Elastic Limit—Soft	9,000	9,000	15,000
Modulus of Elasticity in Tension x 10^6	17	16	15
PHYSICAL CONSTANTS			
Density @ 68°F lbs./cu. in.	0.323	0.323	0.316
Specific Gravity	8.94	8.89	8.75
Melting Pt. °F Liquidus	1981	1978	1880
Solidus	—	—	1810
THERMAL CONSTANTS			
Coefficients of Thermal Exp. per °F from 68°F to 572°F x 10^{-6}	9.8	9.8	10.4
per °C from 20°C to 300°C x 10^{-6}	17.7	17.7	18.7
Thermal Conductivity at 68°F BTU/sq./ft./ft./hr./°F	196	112	92
Calories/cm^2/cm/sec/°C	0.81	0.46	0.38
Thermal Capacity (spec. heat) @ 68°F BTU/lb./°F	0.092	0.092	0.09
@ 20°C cal./gm./°C	0.092	0.092	0.09
ELECTRICAL CONSTANTS			
Resistivity ohms/mil foot @ 68°F (annealed)	12.2	24	28
Conductivity % IACS @ 68°F (annealed)	85	45	37
(annealed) megmho-cm^3 @ 20°C	0.493	0.261	0.215
Resistivity, micro-ohm centimeters @ 20°C (annealed)	2.03	4	4.7
Color	Red	Red	Reddish
FABRICATION PROPERTIES			
Cold working	Excellent	Excellent	Excellent
Hot working	Excellent	Excellent	Good
Hot working Temp. °F	1400-1600	1400-1600	1450-1650
Hot working Temp. °C	750-875	750-850	800-900
Machinability rating	20	20	30
Soft soldering	Excellent	Excellent	Excellent
Silver brazing	Excellent	Excellent	Excellent
Oxyacetylene welding	Fair	Fair	Good
Carbon arc welding	Good	Good	Good
Resistance welding	Poor	Poor	Poor
Polishing	Good	Good	Good
Annealing Temp. °F	700-1200	900-1250	800-1350
SPECIFICATIONS			
A.S.T.M.	B-111-50	B-111-50	B-111-50
U. S. Navy			
Federal			

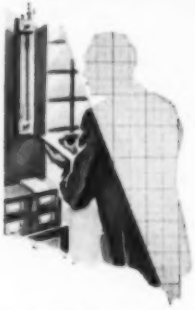
Red brass is superior to the yellow brasses as far as resistance to dezincification is concerned. It also has a somewhat higher heat conductivity than the yellow brasses but less than copper. In fresh waters, red brass and copper are often interchanged with satisfactory results.

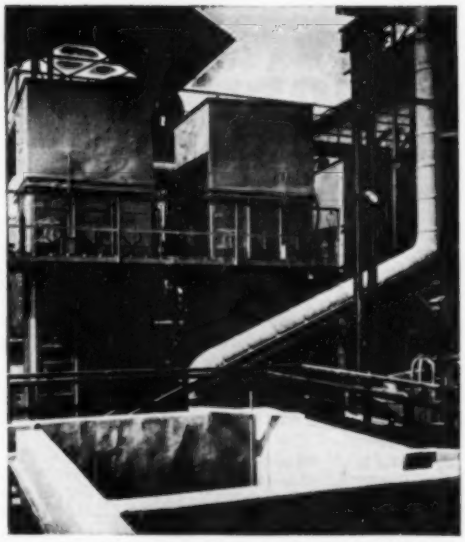
The accompanying table gives the physical and fabrication properties and specifications of Deoxidized Copper, Arsenical Copper and Red Brass, and should be helpful to design engineers.

Tensile and Yield Strength values meet minimum engineering requirements. (8141)

This 'dust' man can help you...

Solve Stack Dust Problems





Buell 'SF' Electric Precipitator for collecting acid mist.

This industrial 'dust' man assures peak efficiency in Dust Recovery

The Buell organization of industrial 'dust' men is devoted solely to the design and construction of dust collection and dust recovery equipment that will most efficiently and economically solve your plant's specific Stack Dust problem.

For more than 18 years we have been doing just this for all American industry. Every Buell installation is a custom-designed system, engineered to hold stack dust discharge down to the practical limits which assure new profits, improved product and/or process, better plant-community relations, higher levels of employee morale.

For full information about Buell's ***3 basic systems*** of dust collection, and how one can be applied to the solution of your stack dust problems, write today. Ask for the new, informative bulletin titled, "The Collection and Recovery of Industrial Dusts." Do it now. Buell Engineering Co., Dept. 12-D, 70 Pine Street, New York 5, N. Y.

ELECTRIC CYCLONIC

buell®

HIGH EFFICIENCY CYCLONES • ELECTRIC PRECIPITATORS
TYPE 'LB' COLLECTORS • LOW DRAFT LOSS COLLECTORS
SPECIAL PURPOSE COLLECTORS • DUST HOPPER VALVES

ENGINEERED EFFICIENCY IN DUST COLLECTION

Sulphur

Shifting Track for loading at one of the storage vats.

Thousands of tons mined daily, but where does it all go?

Two extremes—army jeeps and ladies' lingerie—but with one thing in common... the need of Sulphur in their manufacture! Tires for the jeeps and other vehicles have rayon cord. Much of the lingerie carries the label 'rayon'. And to make viscose rayon requires three prior uses of Sulphur: sulphur in cellulous pulp, sulphur in carbon bisulphide, and sulphur in sulphuric acid.

Present annual production of viscose rayon is around 800,000,000 pounds. Since it takes about a pound of Sulphur to produce a pound of viscose rayon filament, simple arithmetic will disclose the huge tonnage of Sulphur consumed by the rayon industry...and rayon is but one of countless commodities directly or indirectly based on Sulphur.

All industries are sharing in the country's production of Sulphur.

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.

Mines: Newgulf and Moss Bluff, Texas

Before You Buy . . . Consider Micro-Klean

When it comes to clarification, Cuno MICRO-KLEAN can handle a wide range of micronic filtration jobs just as satisfactorily as larger, more expensive filtering systems.

A MICRO-KLEAN is a *simple, inexpensive* unit, economical to install and operate. First cost is low. Maintenance cost is low.

It is *efficient* because it works by a positive mechanical principle —the only micronic filter to do so.

It is *economical* because of its greater dirt-holding capacity which means fewer cartridge changes. Thus, larger batches can be handled with each set of cartridges.

This greater capacity results from maximum porosity (85-90%) and exclusive "graded density in depth." Thousands of tiny fibres are carefully distributed through the structure to form interstices into which the solids are trapped.

The cartridge gets its strength from resinous impregnation and polymerization.

Easy Replacement

Simply remove cover . . . lift out old cartridge . . . drop in new. Minimum of mess or bother.

GUARANTEED to remove 100% of all solids for which it is rated plus a large percentage down to 1 micron. Cartridge densities: 10, 25, 50 microns. Capacities: a few to over 800 gpm.

It is the lowest-cost device you can use to solve a wide range of micronic filtration problems.

Cuno Engineering Corporation
Dept. 104D, South Vine Street, Meriden, Conn.

Please send information on Cuno MICRO-KLEAN for following service.....

.....

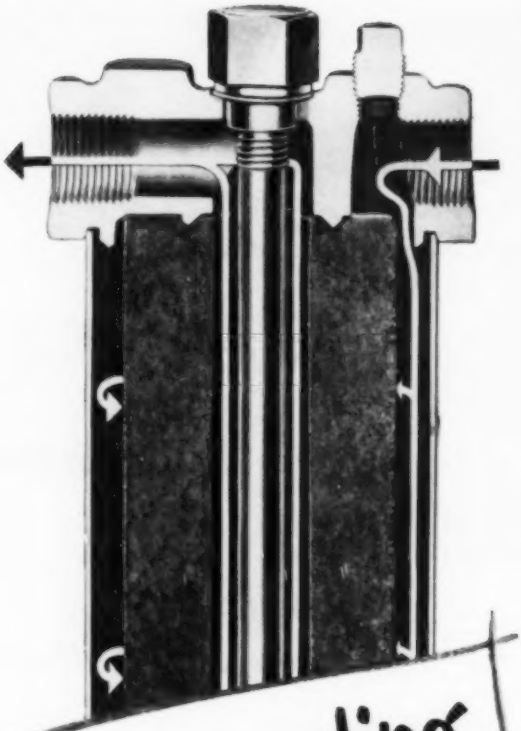
Name.....Title.....

Company.....

Address.....

City.....Zone....State.....

Please attach to business letterhead



No Channeling with this micronic filter

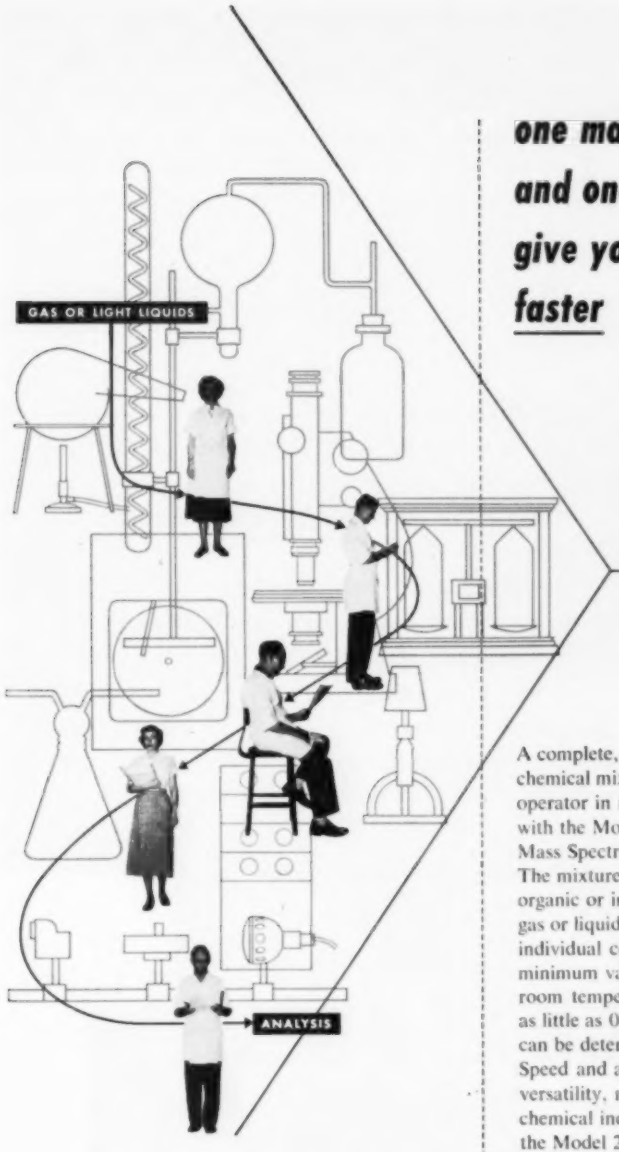
Won't shrink, won't swell. Won't harden, won't soften. Won't distort in any way. That's Cuno MICRO-KLEAN . . . the filter that outlasts any other replaceable-cartridge filter 2 to 1!

CUNO

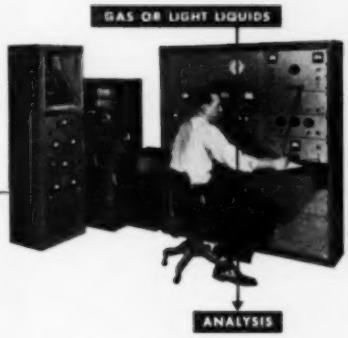
Fluid Conditioning

Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN



one man and one instrument give you better answers faster



A complete, accurate analysis of a complex chemical mixture can now be made by one operator in minutes instead of hours or even days with the Model 21-103 Consolidated Mass Spectrometer.

The mixture being analyzed may be composed of organic or inorganic compounds. Virtually any gas or liquid sample may be handled so long as the individual components in the mixture exert a minimum vapor pressure of 250 microns at room temperature. Trace impurities constituting as little as 0.001 mole per cent of the mixture can be determined.

Speed and accuracy of analysis, together with versatility, make this the ideal instrument for the chemical industry. For further information on the Model 21-103, write for Bulletin CEC-1800B.

consolidated engineering corporation

Analytical Instruments for Science and Industry

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Pasadena 8, California

analytical mass spectrometer

***analytical service**—analysis by mass spectrometry is offered to those whose quantity of samples does not justify the purchase of an instrument. For costs, handling of samples and other details, write for Consolidated's Analytical Service Bulletin.*

ORONITE CHEMICAL COMPANY

THE NAME TO WATCH IN CHEMICALS

Where industry had the "need" Oronite Chemicals supplied the way

A partial list of ORONITE PRODUCTS

Detergent Alkane
Detergent Slurry
Detergent D-40
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Wetting Agents
Lubricating Oil Additives
Cresylic Acids
Gas Odorants
Sodium Sulfonates
Purified Sulfonate
Naphthenic Acids
Phthalic Anhydride
Ortho-Xylene
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WHEN synthetic detergents began to revolutionize the nation's washing habits, the soap industry needed huge quantities of the basic chemicals from which detergents are made. Oronite became, and still is, a major supplier of these chemicals.

Our specialty is mass-producing needed chemicals for industry. Oronite products meet the highest standards of purity, uniformity and dependability.

Perhaps we already have the chemical to improve your product or process. Possibly we can put a chemical you need in mass production. A letter or telephone call will place our experience and facilities at your disposal.

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are available now—
some are in short supply
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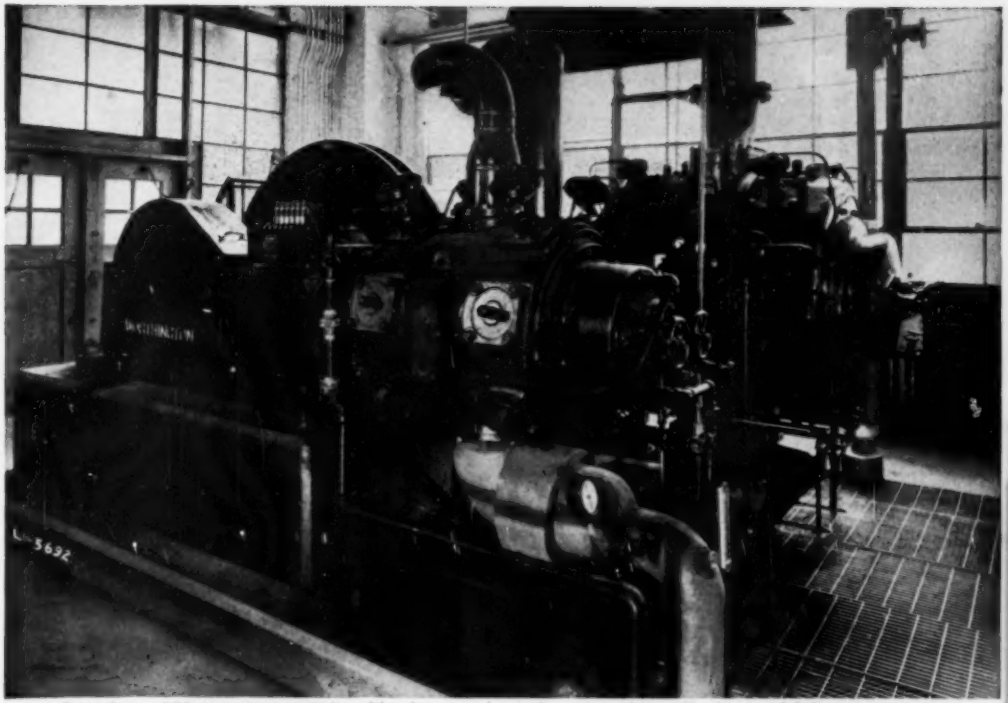


One of over 300 compressors purchased by the same chemical company. It's a Worthington DC-2 gas compressor.

What One Word—Here—Solved Over 300 Compressor Problems?

Over 300 times in the past ten years, a mid-western chemical company has had a compressor problem.

Sometimes the problem involved a small compressor, sometimes a giant. All types of drives. All types of applications—including pulling a vacuum. Almost invariably, they solved the problem with one word—"Worthington".

To help solve *your* compressor problems, Worthington offers *more* compressors for compressing *more* gases than any other manufacturer.

*Reg. U. S. Pat. Off.

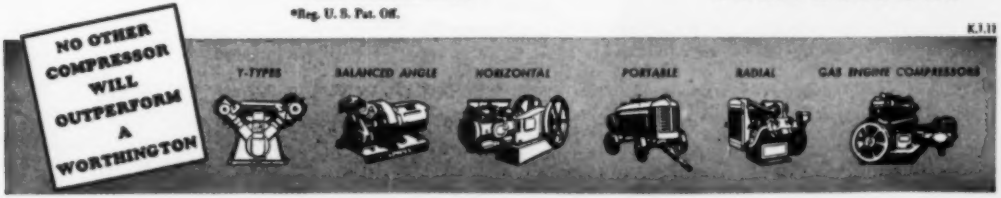
Remember, too, that Worthington compressors are the only ones with Feather* Valves—the simplest, lightest, highest quality valves made.

Write for Bulletin . . . to Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, N. Y.

WORTHINGTON

COMPRESSORS

K.1.11



Jones

WORM-HELICAL SPEED REDUCERS

Jones Worm-Helical Speed Reducers are high efficiency units built in fifteen standard ratios from 40 to 1 to 250 to 1 for all common motor speeds. They are ideal for vertical shaft drives to agitators, mixers, bending rolls, etc.

The low speed shaft can be extended up or down, for coupling connection or gear drive.

Bulletin No. 75 covers complete details.

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4414 W. Roosevelt Rd., Chicago 24, Ill.

Since 1910
Jones
In The Service Of Industry

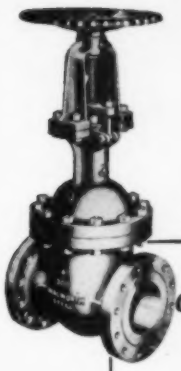
WORM GEAR SPEED REDUCERS
CAST GEAR BLANKS • CUT GEARS • V-BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS • FLEXIBLE COUPLINGS

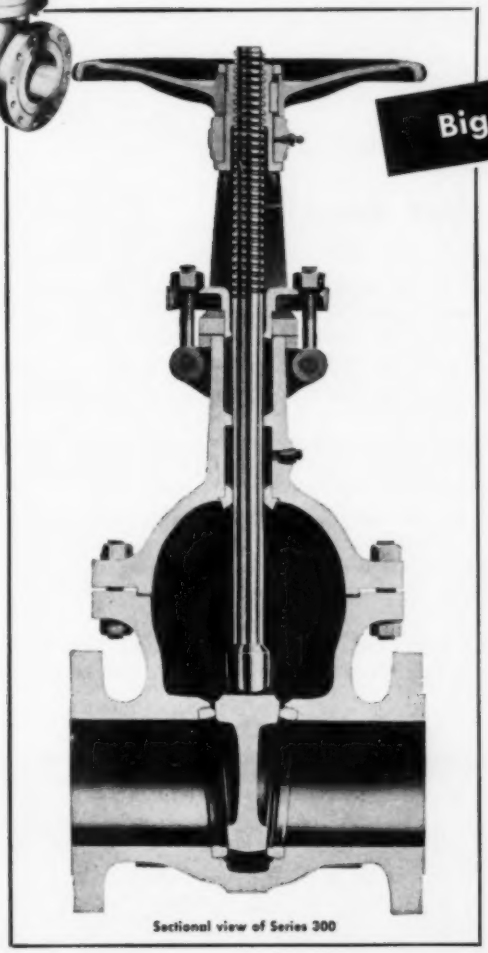
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2″ to 24″) insure tightness and maximum packing life — costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion — they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated — not flange type. No recess exists at back of ring — hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

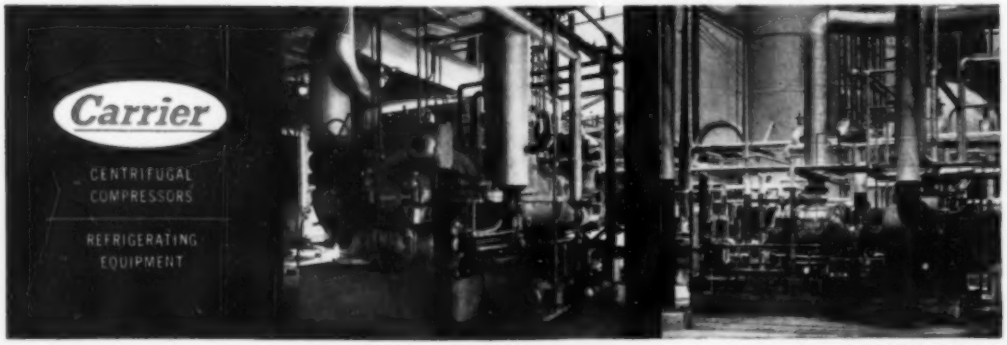
What makes them all go for one?

You know that all over the country alkylation units are being built or reactivated to supply higher octane gasolines for both defense and civilian needs. But did you know that just about every one of them uses the Carrier Centrifugal Compressor?

Why this amazing record? Well, first, there's no need for complex control equipment when you use the Carrier Centrifugal – it maintains exact temperature and pressure levels without them. Then, too, in case acids should ever escape, the Carrier Centrifugal Compressor – and only the Carrier – gives you the extra protection of lead-coated wheels.

But we think one single important word tells the main reason for the Carrier Centrifugal's popularity. *Experience.* Experience for more than thirty years, building more multi-stage centrifugal compressors than anyone else in the business. That kind of experience is worth taking advantage of, don't you agree?

We'd like you to have our catalog, "Centrifugal Compressors for Industry." Ask for it at the nearest Carrier office, or write Carrier Corporation, Syracuse, New York.



Both the hydrofluoric acid alkylation unit at Sinclair Refining's Corpus Christi plant (left) and Mid-Continent Petroleum's sulphuric acid alkylation unit in Tulsa use Carrier 350 series Compressors. Carrier Centrifugal Compressors are built in standard designs from 2000 to 40,000 cfm., with three to seven wheels.

An all-purpose **PROCESS PUMP**

Featuring:

RUGGED CONSTRUCTION

LONG "IN SERVICE" CONTINUITY

EASE OF MAINTENANCE

COMPLETE SIZE RANGE

PEERLESS PUMPS

PEERLESS TYPE DS CHEMICAL PROCESS PUMP

ESPECIALLY DESIGNED FOR YOUR CHEMICAL PROCESS APPLICATIONS

Simplicity in construction, ruggedly designed frame, case and liquid end, grease- or oil-lubrication, open or enclosed impeller construction; these are some of the many features of Peerless Type DS chemical process pumps. High temperature oil-lubricated type is provided with water-cooled packing gland and back plate. Grease-lubricated type is recommended for temperatures below 250° F. Mechanical shaft seal can be furnished when specified. The Peerless Type DS is one of the truly all-purpose chemical pumps available to industry today. A new Peerless bulletin gives you the complete details.

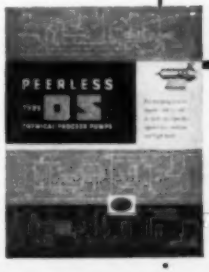
HERE ARE TYPE DS CHARACTERISTICS

CAPACITY: Up to 1500 gpm. **HEADS:** Up to 231 feet. **SIZES:** Complete range, 1 in. through 6 in. **IMPELLER:** Open or enclosed design, depending upon your requirements. **LUBRICATION:** Grease- or oil-lubrication, depending upon temperatures or intended service. **PACKING GLAND** or **MECHANICAL SHAFT SEAL** design available. Equipped with **CASE WEARING RINGS** for extra-low maintenance costs and extra-high maintained efficiencies. **LIQUID END** can be of any alloy.

PEERLESS BUILDS *Dependable* PUMPS

WRITE FOR BULLETIN

Completely describes and illustrates the Peerless Type DS chemical process pump. Profusely illustrated with cutaway pump views, sectional drawings, elevations and dimensional data and contains performance and complete construction details. Mail coupon today for your copy.



PEERLESS PUMPS fmc

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Address inquiries to Factories at:
Los Angeles 31, California and Indianapolis 8, Indiana.
Offices: New York, Chicago, St. Louis, Atlanta, Tulsa; Dallas, Plainview and Lubbock, Texas; Fresno, Los Angeles; Phoenix, Albuquerque, N. M.

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

Please send us a copy of Peerless Type DS Pump Bulletin No. B-1600.

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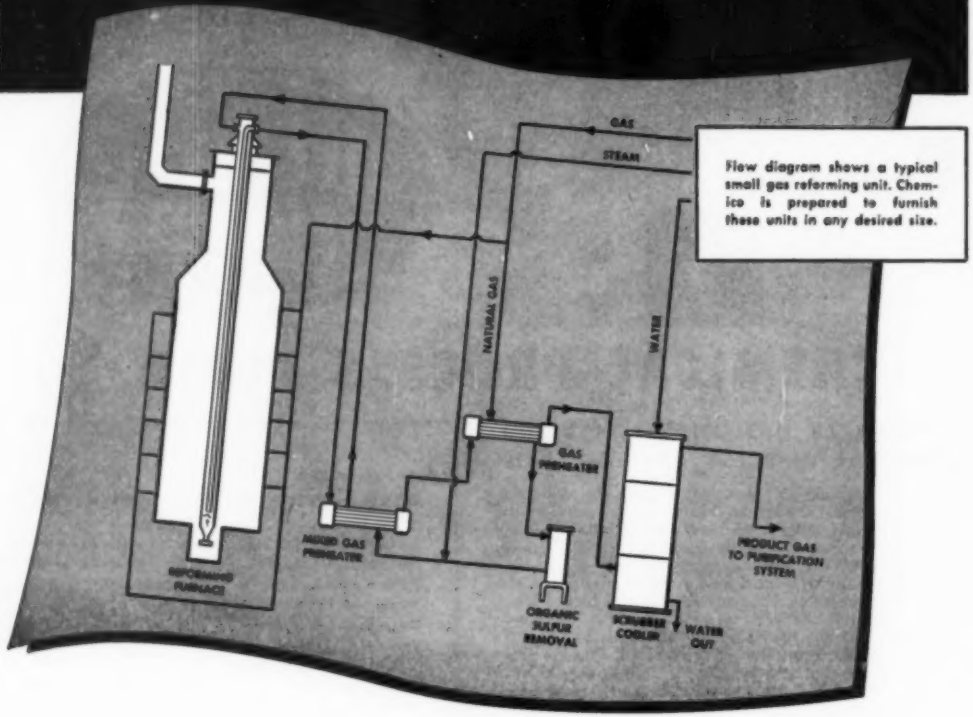
CHEM. ENG.

Produce Hydrogen

OR HYDROGEN MIXTURES

at Low Cost with a Chemico Plant



Flow diagram shows a typical small gas reforming unit. Chemico is prepared to furnish these units in any desired size.

Chemico offers units for the production of hydrogen mixtures by the catalytic reforming of hydrocarbon gases such as natural gas, propane and butane. For synthesis work, product gas can be limited to trace amounts of impurities. Other Chemico units may be used to produce controlled ratio mixtures of hydrogen with carbon monoxide, carbon dioxide or nitrogen.

Chemico has built these reforming plants in various sizes, ranging in capacity from 150,000 cfd. to 24,000,000 cfd. These plants are simple to operate, have virtually automatic centralized control, and are highly efficient.

If your plans call for producing hydrogen or a hydrogen mixture for any industrial use, write us about your specific application.

CC 231

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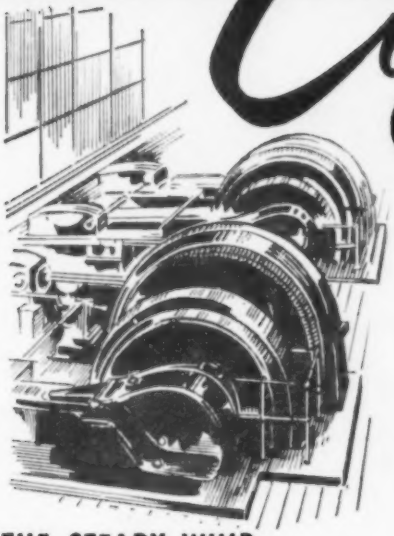
Chemico plants are profitable investments

IT'S GOT TO BE *Continuous*

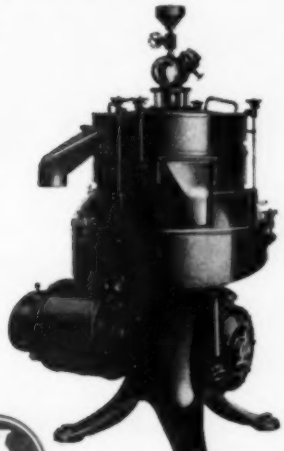
TO BE PROFITABLE!



THE STEADY WHIR OF THE TURBINE

Like the uninterrupted output of the power plant, the flow of a chemical process should never be stop-and-go. To be profitable, each step—including separation and clarification — should build on each previous step. De Laval centrifuges take the lost motion out of (1) liquid-liquid (2) liquid-solid and (3) liquid-solid-and-liquid separations by making each one continuous.

De Laval machines are designed to separate at constant efficiency throughout a long run. Their bowls do not store solids in the stream of liquid being separated, but either store the removed solids against the periphery where they cannot interfere with the incoming flow, or, in the case of the "Nozzle-Matic" Separators, discharge the solids along with some of the heavy liquid.



De Laval has over 70 years' experience in solving problems of separation and clarification. ***Your*** problem may be akin to one that they have already solved.

Write for more specific information. Mention what you want to separate.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

De Laval

CONTINUOUS CENTRIFUGAL SEPARATORS & CLARIFIERS

FOR EASIER PROCESSING SYSTEMS

HEAD LOSS CUT

...as much as 65% to 80% BY CHAPMAN

Tilting Disc CHECK VALVES

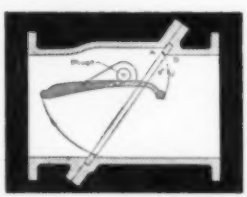
Typical test on a 22-inch Chapman Tilting Disc Check Valve under 450 pounds gas pressure . . . carrying 3,200,000 feet of gas per hour . . . showed a drop in pressure of less than 7 inches of water.

The average reduction of head loss . . . as against conventional check valves . . . is 65% to 80%.

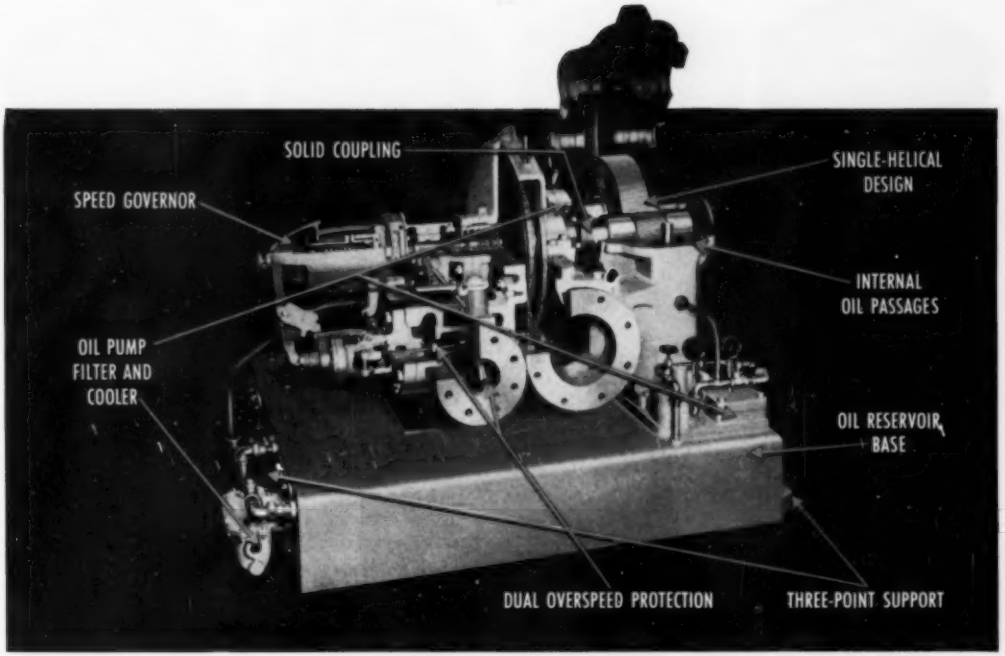
That's because the balanced hinge-pinned disc, of special aerofoil design, has exceptional lifting qualities, lightness in unbalanced weight, and minimum resistance to flow in open position. And valve body is streamlined, with through-way always equal to the area of the pipe.

This means that *disc won't slam* under usual piping arrangements ...and that it seats drop-tight. It means, too, that many new lines can be designed in smaller size. Send for Catalog No. 30, giving complete data and test-curves on Chapman Tilting Disc Check Valves.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting-Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.



TYPE E Gearturbines

Cost Less to Buy . . . Less to Operate

Here's the ideal steam drive for ratings up to 500 hp and output speeds commonly found in single-ended applications such as pumps, fans, compressors, line shafts and generators. It's the Westinghouse Gearturbine that saves you money right from the start. You save on its purchase . . . you save on operating costs.

Save on purchase price because the Westinghouse Gearturbine comes as a complete package. It costs much less than buying a turbine and a separate speed reducer . . . costs less to install, too!

Save on operating costs because every turbine part has been built to give long life and dependable service. An anti-corrosion treatment on vital parts reduces wear and maintenance . . . and there's dual protection against overspeed.

You get these additional features:

Solid coupling of turbine shaft to pinion shaft, makes it easy to align pinion bearings with turbine bearing.

Single-helical gearing; endwise movement of one shaft will not affect axial location of the other. Running clearances are maintained.

Internal oil passages avert accidental damage, improve appearance.

Forced circulation of filtered oil assures thorough lubrication of gears and bearings.

3-point support for maximum ease in leveling and aligning.

Unique oil reservoir forms sturdy base for unit . . . simplifies mounting and installation.

Type E Gearturbines are available in any combination of three wheel sizes, three gears and three types of governor. Your nearby Westinghouse representative has all the facts. Ask him for Booklet B-4346, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-30524

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TYPE E
Gearturbines

Where top performance gets top *protection*

Tri-Sure
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CLOSURES

THE CALIFORNIA OIL COMPANY

protects its drums with *Tri-Sure* Closures

WITH its carefully processed RPM DELO Lubricating Oils and new RPM Motor Oil, The California Oil Company has made "RPM" a hallmark of top-level performance.

To *protect* the performance of these oils—to make sure that the quality they produce is *delivered*—The California Oil Company equips every drum with *Tri-Sure* Closures.*

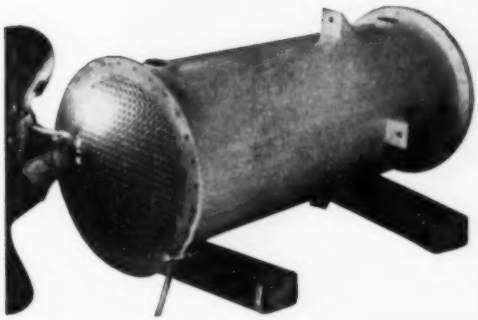
Leading shippers have learned that only fully *dependable* protection is good enough for their products and their investments in them. Losses from leakage, contamination or pilferage can be costly. Eliminate these risks by giving your drums the *proven* security of the Tri-Sure flange, plug and seal. When you order drums, specify "Tri-Sure Closures".

*The "Tri-Sure" Trademark is a mark of reliability backed by 29 years serving industry. It tells your customers that genuine Tri-Sure Flanges (inserted with genuine Tri-Sure dies), Plugs and Seals have been used.

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.
Tri-Sure Products Limited, St. Catharines, Ontario, Canada

T. M. "RPM DELO", "RPM" Reg. U. S. Pat. Off.

Fabricators Can Tell the Difference in *Carpenter* Stainless Tubing



All-Stainless condenser containing 481 Carpenter Stainless Tubes (¾" x 16 gauge, Type 304). The fabricator says: "We have used Carpenter Stainless Tubing for a number of years. In addition to the quality of the tubing, we like the good service we get from Carpenter's distributor."

Perfect seating on tube bundle jobs—easy bending and coiling—are advantages your fabricator can tell you about when he uses Carpenter *Heat Exchanger Quality* Stainless Tubing.

Because of the *wall uniformity* of this tubing, fabrication is not delayed by costly trial-and-error methods. Even on straight pipe line hook-ups, wall uniformity saves time in working with standard fittings and valves.

Analysis, Tolerance and Finish are guaranteed to be "as ordered" on every shipment of Carpenter Stainless Tubing.

NEW SLIDE CHART ON BENDING STAINLESS TUBING

This new Carpenter service can help you conserve material, get best results with Stainless Tubing and Pipe. Covers bending radii, coil diameters for various sizes and gauges. A note on your company letterhead will bring you the new Carpenter Tubing Slide Chart.

THE CARPENTER STEEL COMPANY
Alloy Tube Division, Union, N. J.
Export Department: Carpenter Steel Co., Reading, Pa. "CARSTEELCO"

Carpenter
STAINLESS TUBING

—guaranteed on every shipment

It's the Nash!

The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

- No internal wearing parts.
- No valves, pistons, or vanes.
- No internal lubrication.
- Low maintenance cost.
- Saves floor space.
- Desired delivery temperature Automatically maintained.
- Slugs of liquid entering pump will do no harm.
- 75 pounds in a single stage.

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Celanese' expanded production, research and quality control are ready to serve you. Your most reliable source of Acetic Acid can now be your principal supplier of this vital industrial chemical. New processing methods insure higher quality, greater production, lower costs, and now make Celanese Acetic Acid available to all industry in larger volume than ever before. Contract now for your increasing requirements of Acetic Acid.

Contact our nearest district sales representative, or write to Celanese Corporation of America, Chemical Division, Dept. 553-D, 180 Madison Avenue, New York 16, N. Y.

A Celanese Chemical is always a better buy.

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- **Research that anticipates industrial requirements**
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Celanese® CHEMICALS

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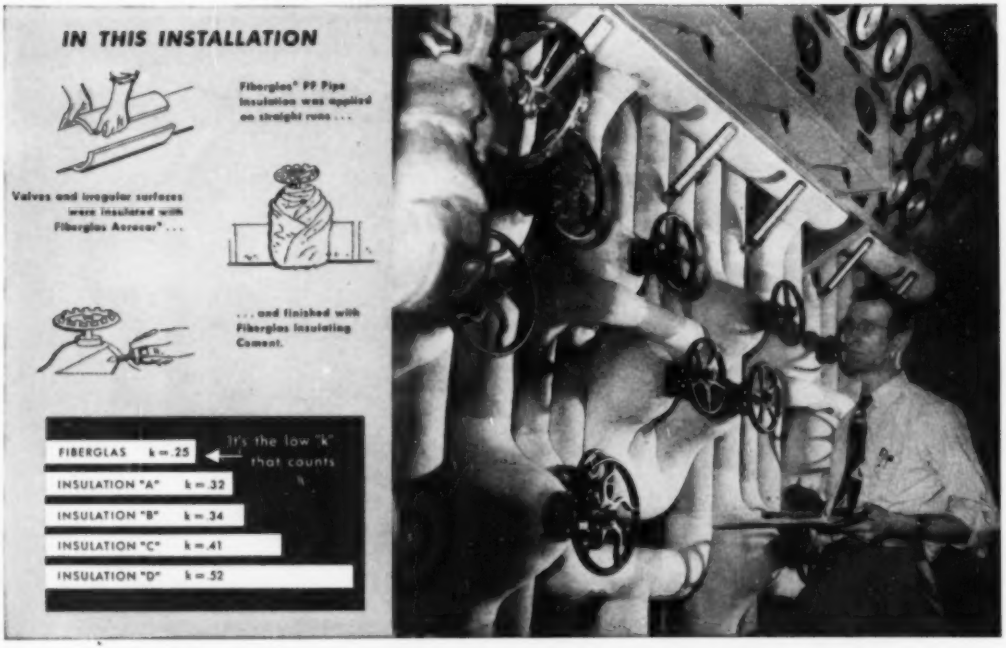

IN THIS INSTALLATION
Fiberglas® PF Pipe Insulation was applied on straight runs . . .
Valves and irregular surfaces were insulated with Fiberglas Asrocor® . . .
. . . and finished with Fiberglas Insulating Cement.
FIBERGLAS k = .25
INSULATION "A" k = .32
INSULATION "B" k = .34
INSULATION "C" k = .41
INSULATION "D" k = .52
It's the low "k" that counts

Save up to 25% more BTU's per dollar with Fiberglas PF Pipe Insulation

It's the "k" that counts. Fiberglas® PF Pipe Insulation is first in efficiency among molded materials for service up to 450° F. As the little chart above shows, the low heat conductivity "k" of Fiberglas Insulation gives superior protection when equal thicknesses are used . . . or in many cases you can use less thickness than with other insulations to obtain equal protection. Either way your costs are lower.

Fast, easy application is another way Fiberglas PF saves money. Available with canvas jacket for indoor use, or with weatherproof jacket for outdoor. *New form* is Fiberglas Dual Temperature Pipe Insulation. Its laminated jacket provides an integral vapor barrier for indoor lines that carry hot water one season and cold water another; or for continuous low-temperature service.

Where heat or cold must be controlled, count on these unique features of Fiberglas Industrial Insulations to produce top results . . . in less time, at lower cost:

- High insulating value
- Light in weight
- Easy to cut and apply
- Economically priced
- Ageless, rotproof
- Non-corrosive
- Low moisture pickup
- Will not shrink

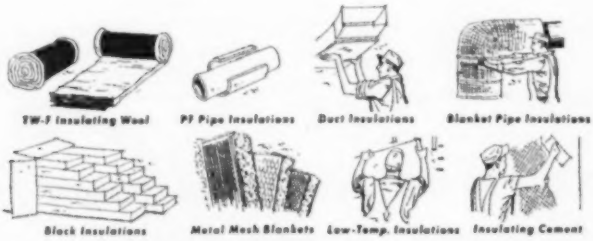
Your Fiberglas Insulation Contractor is ready to put these advantages to work for you. For his name, see the yellow pages of your phone book, or call the nearest Fiberglas Office. OWENS-CORNING FIBERGLAS CORPORATION, Dept. 97-D, Toledo 1, Ohio.

*Fiberglas (Reg. U.S. Pat. Off.) and Asrocor are trademarks of Owens-Corning Fiberglas Corporation for products made of or with fibers of glass.

OWENS-CORNING FIBERGLAS

INDUSTRIAL INSULATIONS

...Where Heat or Cold Must be Controlled!

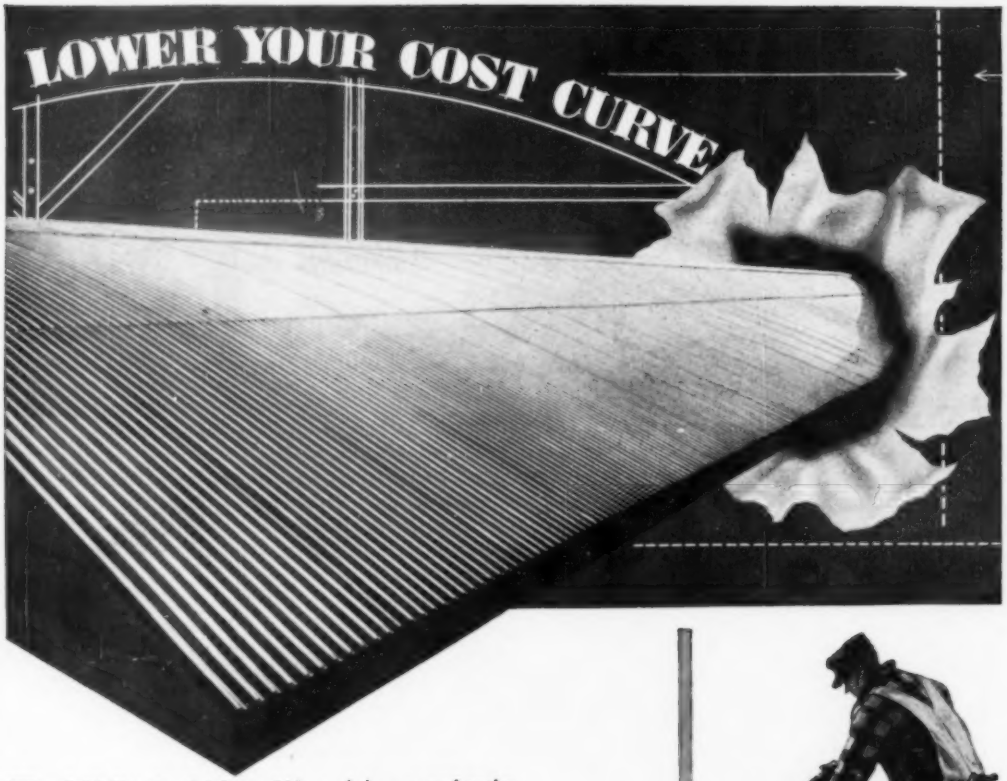


Colorful asphalt floor tile mix uniformly produced in BAKER PERKINS mixers

B-P Mixers are doing a splendid job in all sorts of processing operations, and this installation of six size 15JSE BAKER PERKINS Mixers at a large asphalt floor tile plant is an excellent example. These six mixers can thoroughly blend the ingredients for asphalt floor tile at the rate of 18,000 lbs. per hour on a continuous production schedule. Like other BAKER PERKINS equipment, the cost of operating and maintenance, including labor, material handling, power, and depreciation, are down where they should be. BAKER PERKINS equipment can help cut costs, increase production, and improve the quality of your product, too. Consult a B-P sales engineer or write us today.

BAKER PERKINS INC.
CHEMICAL MACHINERY DIVISION
SAGINAW, MICHIGAN

LOWER YOUR COST CURVE

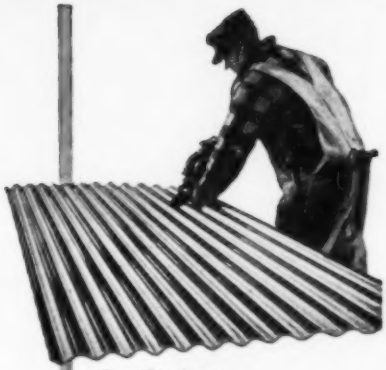


When S. M. Pistorio, of Arbutus, Md., needed a new roof on the curved wood trusses of his big warehouse, he found he could save on initial cost and lower his cost curve through the years with Reynolds *Lifetime* Aluminum Industrial Corrugated.

In this case, 11-foot sheets were used, curved at the site. For other curved roofs, Reynolds can supply curved sheets on request – minimum radius 5'. However, this special use only serves to demonstrate the versatility of aluminum industrial corrugated. On any type of roof it gives the owner the advantages of freedom from rust without protective painting, plus the radiant heat reflectivity that keeps interiors cooler in summer, warmer in winter.

The lighter weight of this roof (56 pounds per square) was especially important on this wood-trussed warehouse. On new buildings this factor can mean substantial savings on framing.

Call Reynolds for technical assistance and application details . . . offices in principal cities. For literature, write to Reynolds Metals Company, Building Products Division, 2042 South Ninth Street, Louisville 1, Kentucky.



Specifications:

Thickness .032"
Corrugations 7/8" deep, 2-2/3" crown to crown
Uniform load support (roof) 80 p.s.f. on 4' purlin spacing
Uniform wind load capacity (siding) 20 p.s.f. on girt spacing up to 7'9"
Roofing width 35", coverage 32"
Lengths 5', 6', 7', 8', 9', 10', 11', 12'

Military demands for aluminum reduce supply, but Reynolds is rapidly expanding aluminum capacity. Rated orders receive priority handling.

REYNOLDS *Lifetime* ALUMINUM INDUSTRIAL CORRUGATED

Tune in every Wednesday . . . "The Kate Smith Evening Hour" on Television – NBC NETWORK

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U.S.I. CHEMICAL NEWS

April ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1952

Chemical Combination Found to Influence Radioactive Decay Rates

Recent research has apparently disproved the once universally accepted axiom that chemical states have no effect on nuclear properties. Observations of spontaneously radioactive technetium and beryllium, and compounds of these metals, are reported to have shown that the rates of decay of the metals vary according to the way in which they are combined chemically. For example, technetium in potassium pertechnate ($KTcO_4$) decays 0.3 per cent faster than the reduced metal, and in its sulfide (Tc_2S_7) it decays 0.03 per cent faster. Beryllium showed a decrease in decay rate in its compounds relative to the metal, according to the report.

A theory advanced to account for these results suggests that the change in decay rate is caused by variations in electron density in the atom close to its nucleus. Change in decay rate at high pressures, also predicted by the theory, was confirmed in the laboratory when technetium metal under 100,000 atmospheres was found to decay 0.025 per cent faster than the metal at normal pressure.

Dehydrogenated Polymers Retain Carbon Structure

It was recently reported that if certain highly cross-linked hydrocarbon polymers, such as polyvinylbenzene or polyvinyl acetylene, are carefully dehydrogenated in an inert atmosphere, most of the carbon-to-carbon bonds survive the process. The result is a polymeric form of carbon which has the same crystalline form as the original hydrocarbon polymer. Providing no carbon is lost, there is no shrinkage in gross size, it is said, but the material gains a porosity which gives it a surface of about ⅛ acre per gram. In spite of its porosity, the carbon polymer is hard, smooth, and extremely refractory. The removal of hydrogen from the polymer is dependent on temperature, and if part of the hydrogen is left in the structure, the material assumes a variety of properties as an organic semiconductor, according to the report. For example, between the temperatures of 700° and 1000° C., removal of hydrogen is such that the specific resistivity of the material changes over a range of 10,000 megohms.

Paint Testing Devices Listed in New Booklet

A new booklet on testing instruments for the paint, plastic, paper, and related industries is now available to the public. Arranged for quick reference, the booklet contains descriptions and illustrations of 80 different testing devices designed for measuring such properties as viscosity, film thickness, drying time, abrasion, hardness, gloss, and reflection.

U.S.I.'s New Allethrin Plant Scheduled for Summer Completion

First Large-Scale Commercial Plant to Begin Insecticide Manufacture in July; Plans Announced For New Pyrethrum Flower Production in Ecuador

U.S.I. has announced that its new Allethrin plant in Baltimore will be completed and in operation by July of this year. Representing the first large-scale commercial production of this chemical in the United States, the new plant will offer additional supplies to help insecticide manufacturers fill the almost limitless demand that exists for safe, effective products. Used as a supplement to pyrethrum, Allethrin will help materially to extend present limited supplies of the natural product and

A view of part of the new plant U.S.I. is building in Baltimore where Allethrin will be manufactured on a large-scale commercial basis.

will facilitate the current rapid expansion in the use of pyrethrum-type insecticides.

A synthetic chemical closely related to natural pyrethrum, Allethrin is the compound that excited the interest of the insecticide world three years ago when its synthesis was first announced by the U. S. Department of Agriculture. Careful evaluation of the chemical by U.S.I. entomologists has shown that while it is not a "synthetic pyrethrum" and some of the early illusions were unfounded, it is a valuable and important chemical in its own right and will be immensely

MORE

Methionine Improves Poultry Feathering

Frequent field observations by poultry growers and feed industry researchers have indicated that methionine supplementation in rations, particularly in summer months, improves feathering. Now experimental data resulting from specific tests under practical field conditions in Texas substantiate this fact.

"Methionine has been found to increase growth, feed efficiency, and definitely improve feathering, particularly during summer months," say the researchers.*

A marked improvement in feathering in the summer months can be achieved by supplementing poultry rations with .05 per cent methionine. The resulting improved dressing quality means more attractive birds for the consumer and greater profits to the grower.

**J. R. Reed, Jr., and J. R. Couch, Texas Agricultural Experiment Station, unpublished data.*

Paper from Glass Fibers Duplicates Natural Quartz

Development of a new, highly specialized glass fiber of sub-micron diameter which chemically duplicates natural quartz was recently announced. The fibers have successfully been made into a quartz paper, the initial use for which will be as high-temperature, non-deteriorating electrical insulation. The paper is reported to have resistance to temperatures up to 3000° F. and to provide minimum electrical losses at high frequencies. Extensive tests are said to have shown it to be relatively unaffected by radiation. The paper is also claimed to surpass the working limit for asbestos and to be capable of replacing it in some applications.

Booklet on Paint Driers

A 31-page booklet recently offered to the public contains complete information on the physical and chemical properties of all types of driers. The data were compiled with the idea of giving the technical man working with drying oils and resins practical information on the selection and use of these materials, the company states.

New Runways for Jets

A new plasticized blend of synthetic rubber and tar, designed for use on airport runways, is expected to be the answer to several problems brought about by the increasing use of jet aircraft. According to the manufacturer, the new material is unaffected by hot jet blasts, and it resists the dissolving effects of spilled fuel. Conventional runways, it is said, slowly disintegrate and become rutted as a result of frequent spillages of the kerosene-type fuel. When this happens, loose fragments of the pavement are kicked up by the jets in taking off, creating a hazard for any planes following in formation. Applied over asphaltic pavement in layers approximately an inch thick, the blend is claimed to be stable to high wheel loads and to provide a relatively non-skid surface.

CONTINUED

Allethrin Plant

useful in insecticide formulations. The final step in its development was U.S.I.'s successful translation of the complex Allethrin synthesis into a full-scale tonnage process. Allethrin will join U.S.I.'s well known and growing family of insecticides which includes the famous Pyrenone*.

Western Hemisphere Pyrethrum

Another milestone in U.S.I.'s progressive insecticide program has been reached by the completion of plans for growing pyrethrum flowers in Ecuador. The project includes the formation of a company to underwrite large-scale plantings of the flowers in a region of the country which up to now has been unproductive. The flowers grown there are the first high-grade ones to be produced commercially in the western hemisphere, and they are described as comparable to the African product in pyrethrum content. Special drying and packing plants are being built near the production areas.

*Reg. U.S. Pat. Off.

New Process Makes Superior Sheet Mica From Domestic Supplies

A process has been developed for treating mica flakes of domestic origin in such a way that a force is generated which holds the particles together, according to a recent announcement. The new production method is said to overcome the inferior quality of American supplies and may necessitate the reactivation of mica mines in this country. The material is produced in the form of a continuous sheet in thicknesses ranging from 0.002 to 0.006 inch. Claimed to have better dielectric strength than present machine- and hand-laid mica products, the mica material can be impregnated with resins and bonded to paper, glass, and cloth. Laminates and tubing are among the applications foreseen for the product.

Temperatures Recorded With Paper Thermometers

Disposable paper thermometers that instantly determine and record temperatures from 115° to 500° F. were described in a recent announcement. Designed originally to be used in studying thermal radiations of atomic blasts, the new instruments are also expected to be useful for testing the performance of engines, motors, heaters, and the like. The thermometers consist of black paper coated with white pigments. Each coating is designed to melt at a designated temperature, at which point it disappears into the black porous paper. Since the change from white to black is not reversible, it constitutes a permanent record of the indicated temperature. The new units are reported to react to temperatures much faster than other indicators based on color changes, and they can be produced inexpensively, it is said.

New Turpentine Chemicals

The development of a new series of chemicals was reported recently which is expected to open up a new market for the naval stores industry. Called terpene hydroperoxides, the new chemicals are derived from gum turpentine and are said to have shown excellent promise in the production of plastics and synthetic rubber. They are described as particularly good catalysts for the "cold rubber" process. Manufacture of the chemicals involves hydrogenation of unsaturated pinenes in turpentine, followed by oxidation with air. Process is said to be simple and to require no special equipment.

X-ray, Infrared Reports Listed in New Book

More than 1300 published reports on x-ray and infrared are listed and indexed in a recent book compiled for the use of chemists, chemical engineers, physicists, and others interested in these fields. The original reports total approximately 50,000 pages and have been selected from prewar and postwar reports of government, industrial, and university laboratories both here and abroad.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U. S. I.

To make plaster casts harder and stronger, a thin, liquid plastic dip is available which reportedly penetrates the hardened plaster and resinifies it upon curing. **(No. 789)**

A new safety valve for 50-gallon drums fits the bung opening, allows air to enter or vapors to escape with changing pressures, and automatically seals itself if the drum turns over, according to the manufacturer. **(No. 790)**

Shredded polyethylene in new filter elements for furnaces and airconditioners is said to become electrostatically charged on exposure to air currents, to retain the finest dust particles, and to be easy to clean. **(No. 791)**

Handling objects as hot as 1200° F. is reported possible with a new heat repelling glove made of aluminum-coated fabric and asbestos. The glove is claimed to reflect up to 90 per cent of radiated heat. **(No. 792)**

A new tallate-type lead drier with improved cold stability, for use in paints and related compositions, flows at temperatures as low as —30° and is readily soluble in oils and vehicles, the manufacturer states. **(No. 793)**

Wearing surface of stainless steel at a cost many times less than that of the solid metal is reportedly obtained with a new plastic coating which contains finely flaked stainless steel particles. **(No. 794)**

An adjustable drum storage rack, designed to eliminate need for shifting stacked drums in order to reach the one desired, handles heavy loads and can be knock-down and rearranged to fit various storage facilities. **(No. 795)**

A putty-like vinyl paste for coating outside surfaces of plating tanks is claimed to be easy to apply and to offer excellent protection from spills of acids and other corrosive chemicals. **(No. 796)**

A new urea resin adhesive, available as a powder, reportedly can be varied to meet many different gluing specifications and is suitable both for assembly joining and as a binder for granulated wood products. **(No. 797)**

Daylight intensity is continuously recorded directly in foot candles by a new automatic device expected to be valuable in exposure testing of paints. **(No. 798)**

PRODUCTS OF U.S.I.

ALCOHOLS
Amyl Alcohol (Isoamyl Alcohol)
Butanol (Normal-Butyl Alcohol)
Fusel Oil—Refined
Propanol (Normal-Propyl Alcohol)
Ethanol (Ethyl Alcohol)
Specially Denatured—all regular and anhydrous formulas
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Super Pyro* Anti-Freeze
U.S.I. Permanent Anti-Freeze
ETHERS
Ethyl Ether, U.S.P.
Ethyl Ether, Absolute—A.C.S.
ACETONE — A.C.S.

ANSOLS
Ansol* M
Ansol* PR
ACETIC ESTERS
Amyl Acetate—Commercial and High Test
Butyl Acetate
Ethyl Acetate—all grades
Normal-Propyl Acetate
OXALIC ESTERS
Dibutyl Oxalate
Diethyl Oxalate
PHTHALIC ESTERS
Dioctyl Phthalate
Dibutyl Phthalate
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OTHER ESTERS
Diatol*
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Ethyl Chloroformate

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Arodure*—urea-formaldehyde resins
Arofene*—pure phenolics
Arolite*—for special flat finishes
Arolint†—room temperature curing phenolic
Araplex*—alkyds and allied materials
Arapol†—copolymer modified alkyds
Ester Gums—all types
Natural Resins—all standard grades
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Piperonyl Butoxide
Piperonyl Cyclonene
Pyrenone* Concentrates: Liquid & Dust
Pyrethrum Products: Liquid & Dust
Rotenone Products: Liquid & Dust
INSECTIFUGE MATERIALS
Indalone*
Tripla-Mix Repellents

INTERMEDIATES
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Acetoacet-ortho-chloranilide
Acetoacet-ortho-toluidide
Acetoacet-para-chloranilide
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Our latest catalog WG-51 gives full details of our worm gear units. Write for a copy using your business letterhead.

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Write for samples and further information on these uniform Neville solvents.

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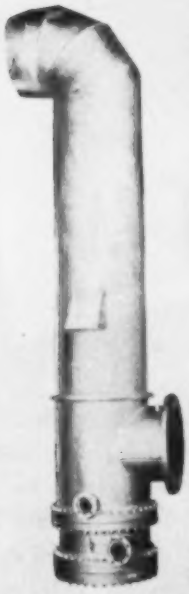
Plants at Neville Island, Pa., and Anaheim, Cal.

Part of Neville's current expansion program is this new plant recently completed at Neville Island, for the production of NEVSOLV Solvents

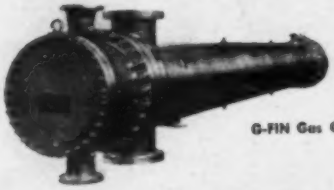
A-43

Why G-FIN is superior for all these heat transfer duties



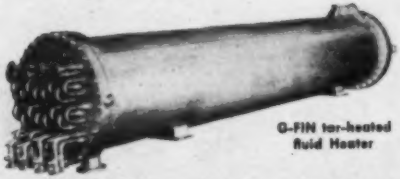
G-FIN Condenser for vapors of viscous liquids

Twin G-FIN Section for heating or cooling fluids of low heat conductivity

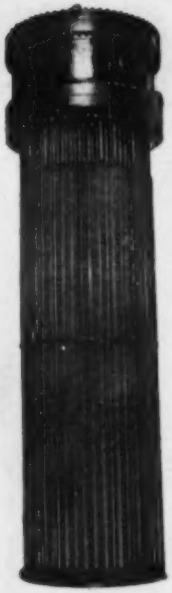


G-FIN Gas Cooler

G-FIN Heat Exchanger for viscous liquids or gases of low heat conductivity



G-FIN tar-heated fluid Heater



G-FIN Contactor Bundle for removing heat of a reaction

If your processes involve transfer of heat between fluids of unequal heat conductivity — these are the types of services for which G-R G-FIN apparatus is far superior to conventional units with bare tubes.

The longitudinal fins on the outside of G-FIN elements have six to eight times the heat transfer surface on the inside of the elements. Therefore, when a fluid of higher heat conductivity flows inside the elements, these fins provide the additional surface needed by a fluid of lower conductivity flowing outside the elements.

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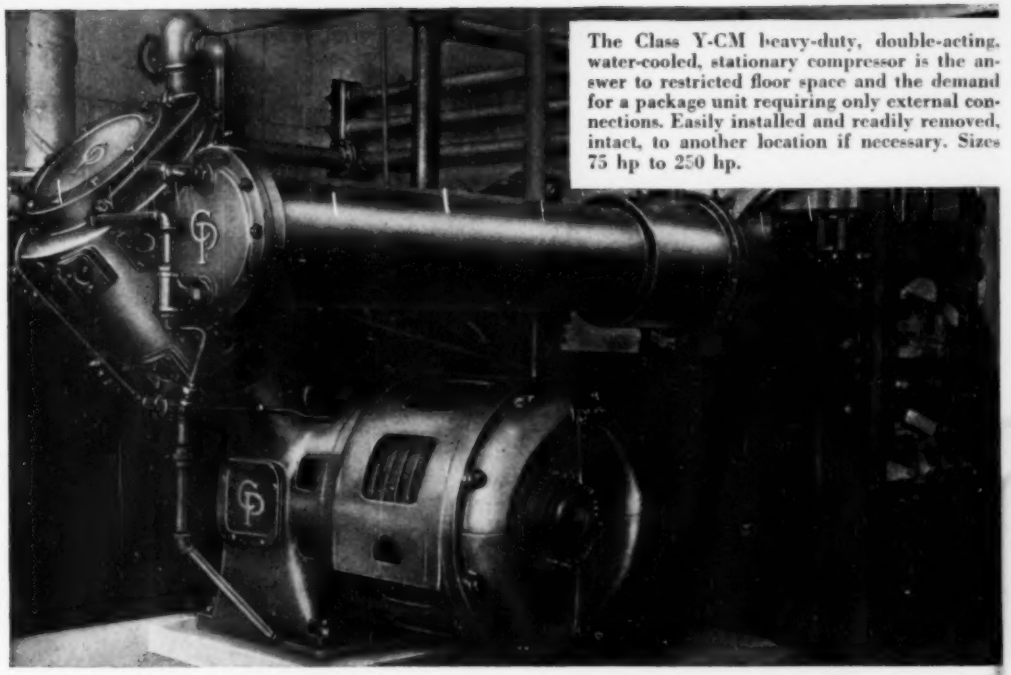
THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GR-991

GRISCOM-RUSSELL

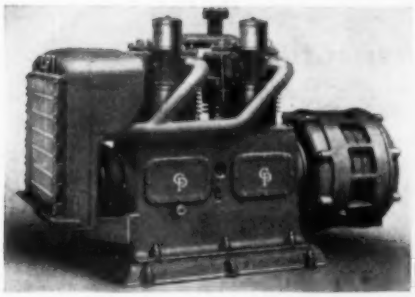
PIONEERS IN HEAT TRANSFER APPARATUS



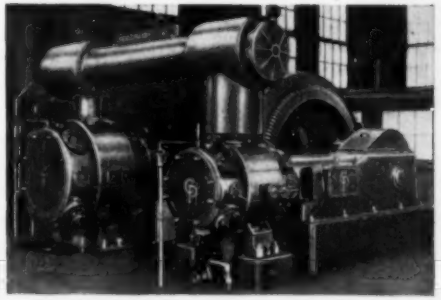
The Class Y-CM heavy-duty, double-acting, water-cooled, stationary compressor is the answer to restricted floor space and the demand for a package unit requiring only external connections. Easily installed and readily removed, intact, to another location if necessary. Sizes 75 hp to 250 hp.

dependable, low maintenance compressors

from 7½ hp to 2000 hp



The small, compact, two-stage Class PM compressor—air-cooled for all-weather operation—may be installed independently of main air system. Also suitable for off-hour operations. Sizes from 25 hp to 100 hp. Available with built-in motor, flexible coupling or V-belt drive.



Built in the larger sizes — up to 2000 hp, Class O-CE horizontal duplex motor-driven compressors meet all load demands most economically, and "last forever."

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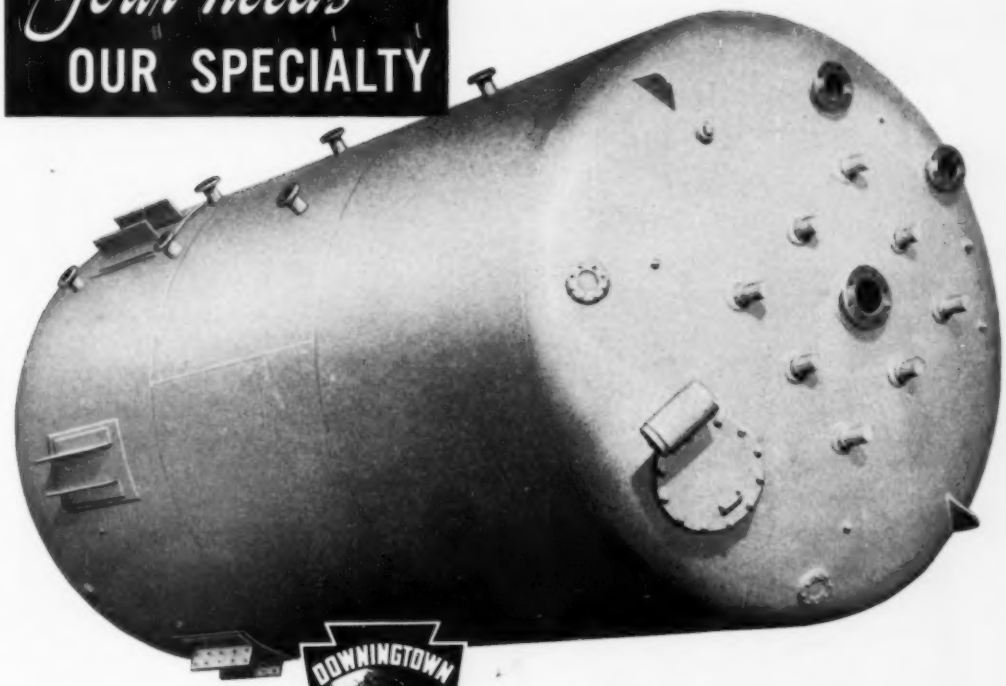

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One of 4 Fermentors, 12'0" x 22'7" high tangent. 10% Stainless Clad, type 304 Stainless . . . manhole body and connections type 304 Stainless. Each fermentor equipped with coils of 3" O.D. x 14 ft. tubing . . . type 304 Stainless. Tested to 80# Hydrostatic . . . produced in accordance with case 896 of the A.S.M.E. Code.

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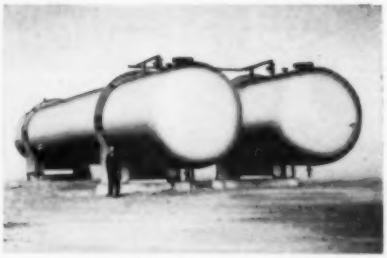
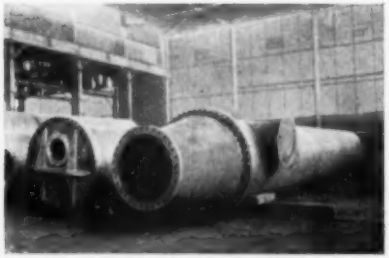
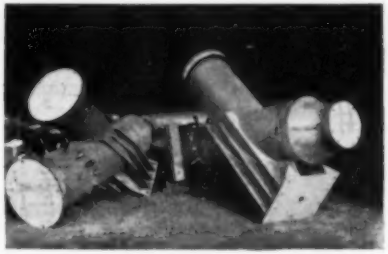


Posey Iron Works twin-tank installation for prominent public utility.



72" diameter headers for water intake lines fabricated throughout in our shops.



Alloy Steel Pipe awaiting shipment from the Posey Iron Works.

The Posey Iron tank illustrated provides 100,000 gallons of *safe* storage because forty-two years of experience went into its fabrication. And the real safety factor in any tank is the sum of its maker's experience . . . skill . . . facilities . . . and shop practices.

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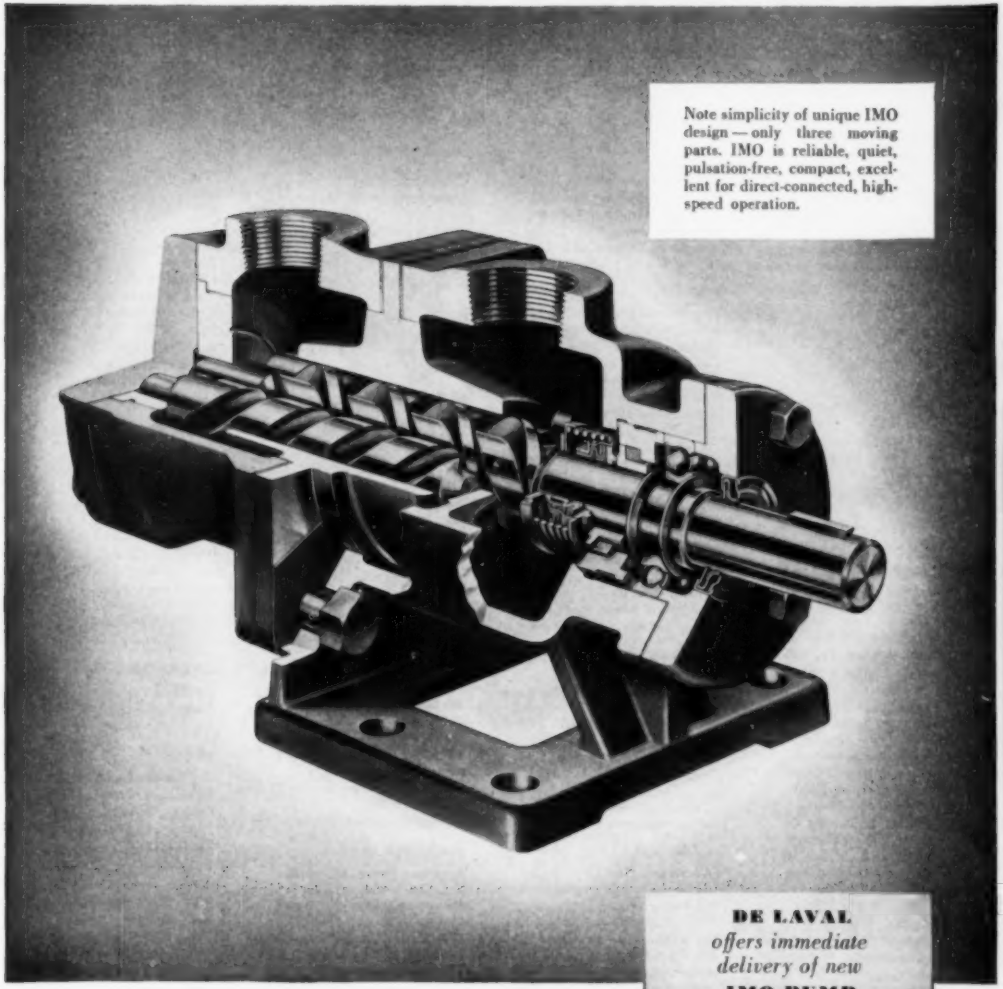

Note simplicity of unique IMO design — only three moving parts. IMO is reliable, quiet, pulsation-free, compact, excellent for direct-connected, high-speed operation.

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Write today

DL 149

This newest De Laval IMO pump — Model A313B — can be used profitably on a wide variety of hydraulic applications for higher pressures. Quantity-produced to help trim your costs, the new IMO saves you up to 40% in initial cost over other IMO models for pressures up to 275 psi. In addition, this quality-designed rotary positive displacement pump gives you all the low-maintenance advantages of the famous IMO pumping principle.

Put the new De Laval IMO A313B pump to work handling light or viscous fluids in hydraulic systems, rotary and steam atomizing oil burners, lubrication, governing systems and similar services. Specify it for capacities to 80 gpm, pressures to 275 psi and intermittent pressures to 325 psi.

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Complete Process Control . . . from billet – to tube – to fitting

assures you the finest in WELDING FITTINGS

Only Globe's precision process of manufacturing seamless welding fittings *begins with the billet*! For Globe alone among welding fitting manufacturers produces seamless tubing . . . and Globe alone has the facilities to provide exact technical control at every stage of manufacture — from billet — to tube — to fitting — *in its own plant*. That's one reason why users who want dependable fittings specify Globe!

GLOBE STEEL TUBES CO.
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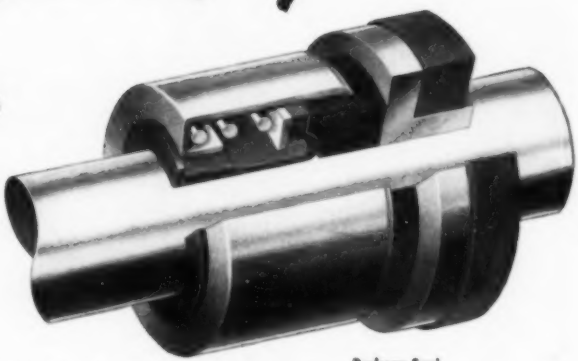
Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — alloy — carbon — seamless steel tubes — Globeiron (high-purity ingot iron) seamless tubes — Globe Welding Fittings.

For complete information on the finest welding fittings available anywhere, send for the Globe Welding Fittings Catalog.

Garlock Mechanical Seals Save 3 Ways!

1. **REDUCE LEAKAGE OF COSTLY OR HAZARDOUS LIQUIDS ON ROTATING SHAFTS**
2. **NO WEAR ON SHAFT OR SHAFT SLEEVE**
3. **LONG LIFE WITH LESS PRODUCTION LOSS AND LOWER REPAIR COST**



Package Seal

It is most economical to use Garlock Mechanical Seals whenever *leakless* operation of rotary shafts on pumps or other equipment is required.

Once the proper Garlock Mechanical Seal has been installed on a rotary shaft you can forget about leakage. A leakless seal is provided by a positive contact between carefully lapped metal-to-carbon or metal-to-metal mating surfaces.

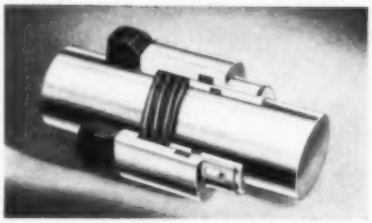
Garlock Mechanical Seals are recommended for use on rotating shafts against practically any liquid including strong acids. All metal parts are available in a variety of corrosion-resistant materials.

The CHEVRON* Seal, for pressures up to 200 p.s.i., and the "O"-Ring Seal, for pressures up to 1000 p.s.i. and over, are individually engineered for each application.

The Package Seal is a low-cost, production-run seal for pressures up to 150 p.s.i. Package Seals of standard construction (brass case and brass washer) are stocked at the factory, for shafts size ⅜" to 2", advancing by sixteenths, and for shafts size 2" to 3", advancing by eighths.

For complete information write for our Mechanical Seal Booklet or ask your Garlock representative.

CHEVRON* Seal



"O"-Ring Seal

*REGISTERED TRADEMARK

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PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK **PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS**

WHERE

does "pioneering" stop?

Well . . . we can tell you that with us it *never* stops.

Even after developing low-cost tonnage ozone, Welsbach *continues* to "pioneer" in ozone research . . . extending Welsbach know-how to help potential users find the effective application of ozone to their particular problems.

The numerous commercial applications of Welsbach Ozone are conclusive evidence that it is fast becoming the *preferred* oxidant. In chemical processing, in industrial waste treatment, in water purification—in fact, wherever an oxidant is required—Welsbach Ozone should be considered. And Welsbach engineering know-how is at your service . . . when and if you want it.

If oxidation is a step in your process, investigate Welsbach Ozone. It is a truly low-cost, efficient oxidant . . . with these plus features:

- **No storage problem; no procurement problem; no materials handling.**
- **No full-time supervision or labor required.**
- **Generated at point of use with equipment requiring little space.**
- ***And* constant, predictable operating cost.**

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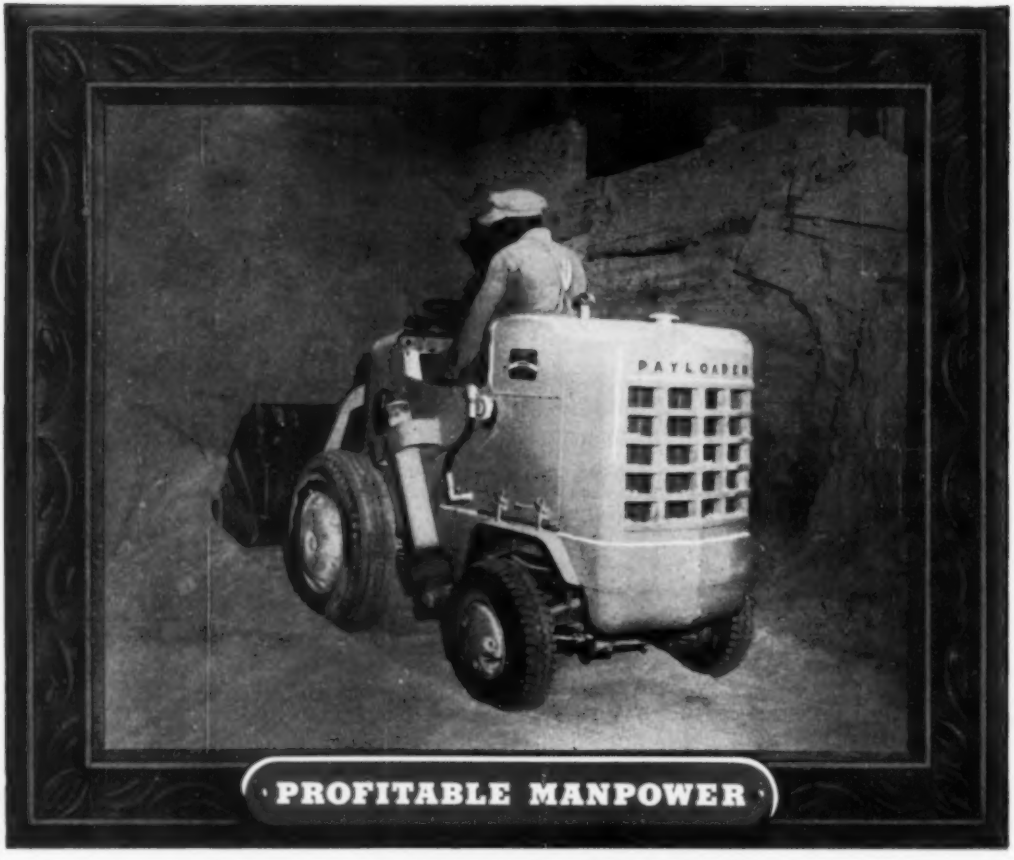
Pioneers in Continuing Ozone Research



This man may have been good with a wheelbarrow and hand shovel, but his productive capacity is several times greater as a "PAYLOADER" pilot. He's happier and so is his boss, because they both make more money.

"PAYLOADER" tractor-shovels are helping fertilizer and chemical plants slash production costs. They actually pay for themselves in a few months doing the many jobs listed here . . . doing them faster and cheaper — and release manpower for more productive work.

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FOR MANY JOBS. *Unload box cars — dig and carry fertilizers, chemicals and all loose materials — feed conveyors, hoppers, baggers, elevators — unload trucks — load box cars — carry bagged materials — clean up aisles, gangways — maintain private roadways — stockpile and carry coal — handle ashes — remove snow — spot cars — lift, haul, push, pull.*

TO FAT PAY

and "Industrial Handling" is full of profitable ideas developed by "PAYLOADER" users. A request on your letterhead gets you on the regular mailing list without cost.

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SAVE 90% OF CHROMIC ACID

Used in Anodizing

Newly Discovered Permutit Process Helps to Conserve This Critically Short Material
1. Produces a more uniform corrosion-resistant surface on the anodized metal.
2. Lowers water consumption by recycling rinse water.
3. Eliminates waste disposal problems by removing impurities from the bath and chromates from the rinse water.

CHROMIC acid anodizing of aluminum used to be an expensive operation, because it wasted valuable acid. Now you can prevent this expensive waste with the NEW Permutit process for chromic acid recovery.

First, a Permutit Q cation exchanger removes contaminating metallic cations which would otherwise consume chromic acid in the bath solution. The chromic acid content remains uniform throughout. Regeneration of the Permutit Q is with cheap sulfuric acid.

The Permutit S anion exchanger removes all chromates from the rinse water. *No water containing chromates is sent to waste.* All chromates are returned to the anodizing bath.

In these days of high costs and critical shortages, the value of the recovered chromic acid will more than pay for the operation of this new Permutit process. The process is equally applicable to other metal working processes consuming chromic acid.

* * *

For full details, write to The Permutit Company, Dept. CE-4, 330 West 42nd Street, New York 36, N. Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

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Plants at: Clairton, Pa.; West Elizabeth, Pa.; and Chester, Pa.

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HAGAN Compensated Ring Balance Meters

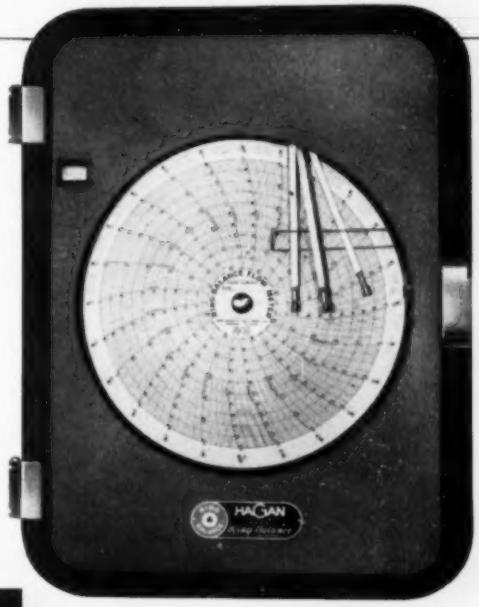
provide *accurate, automatic* compensation

- for *temperature*
- for *pressure* or
- for *pressure and temperature*

When you measure flow of liquids or gases, and pressure and temperature variations occur, there are two ways to correct meter readings—one by expensive and laborious clerical calculations, the other, by using the Hagan Compensated Ring Balance Meter in the first place. This Hagan Compensated Meter corrects *automatically* for variations in pressure, temperature, or pressure and temperature, and makes a chart record of both the corrected and the uncorrected flow. The built-in integrator totalizes the corrected flow automatically.

Dependable Hagan Ring Balance Meters are simple, ruggedly built, and designed for years of trouble-free service. Some features of Hagan Ring Balance Meters include:

- **Mercury level not critical**
- **Ease of dead-weight calibration**
- **No stuffing boxes or pressure-tight bearings**
- **High sensitivity at low flow rates**
- **Adjustable, full-scale range**



Whatever your metering problems, our engineers are at your service. For full information, phone, wire, or clip the coupon.

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2. PROFITABLY MEET YOUR EXACTING REQUIREMENTS

3. BY DOING THE JOB BETTER AT LOWER COST

4. AND THE RESULT FOR YOU — GREATER PROFITS

1. For concentrating Chemicals, Pharmaceuticals, Antibiotics, and Food Products, BUFLOVAK Evaporators offer worthwhile operating advantages.

2. Advance design, in many types, with such features as low operating temperatures, high vacuum, immaculate cleanliness, simplified operation, and automatic controls, give you the product you want.

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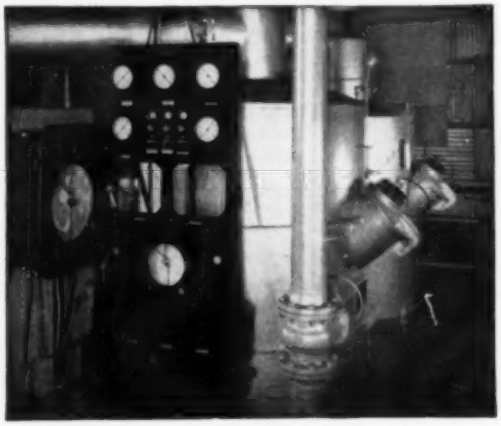
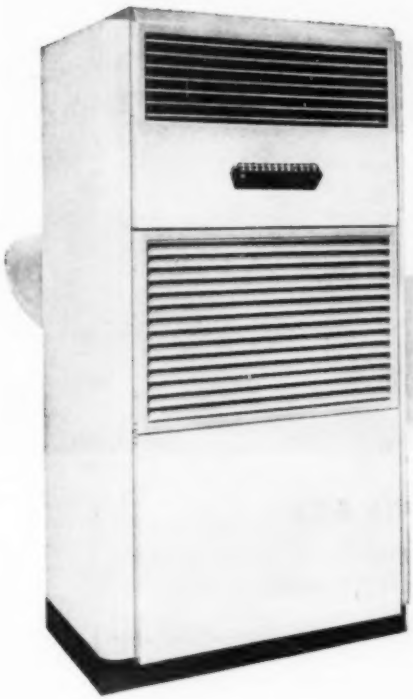


There's a superb WESTINGHOUSE UNITAIRE® CONDITIONER



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Best of all, the UNITAIRE is the best looking, most reliable air conditioner you can buy. One reason is the famous Westinghouse hermetically-sealed compressor. There are other important reasons your Westinghouse Air Conditioning Distributor will be glad to explain. Call him today; he's listed in the Yellow Pages of your telephone directory. Or, write for free booklet to Westinghouse Electric Corp., Air Conditioning Division, Hyde Park, Boston 36, Mass.

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YOU CAN BE SURE... IF IT'S Westinghouse

S-A REDLER Conveyors deliver cellulose acetate from the bottom of a silo to other silos or to processing at the Kingsport Tennessee plant of The Tennessee Eastman Company. An operator is shown taking a sample of material from one of the completely enclosed REDLER Conveyors. An S-A Circular Bin Discharger is also shown below the silo.

S-A CONVEYING *Systems* for AUTOMATIC STORAGE and delivery of chemicals without CONTAMINATION

REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
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Write for Bulletins on any of the above

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It is the S-A engineer's every job to adapt handling methods and equipment to specific situations. For a low-cost-per-ton solution to your particular conveying problems ask an S-A engineer for a recommendation . . . there is no obligation, of course.

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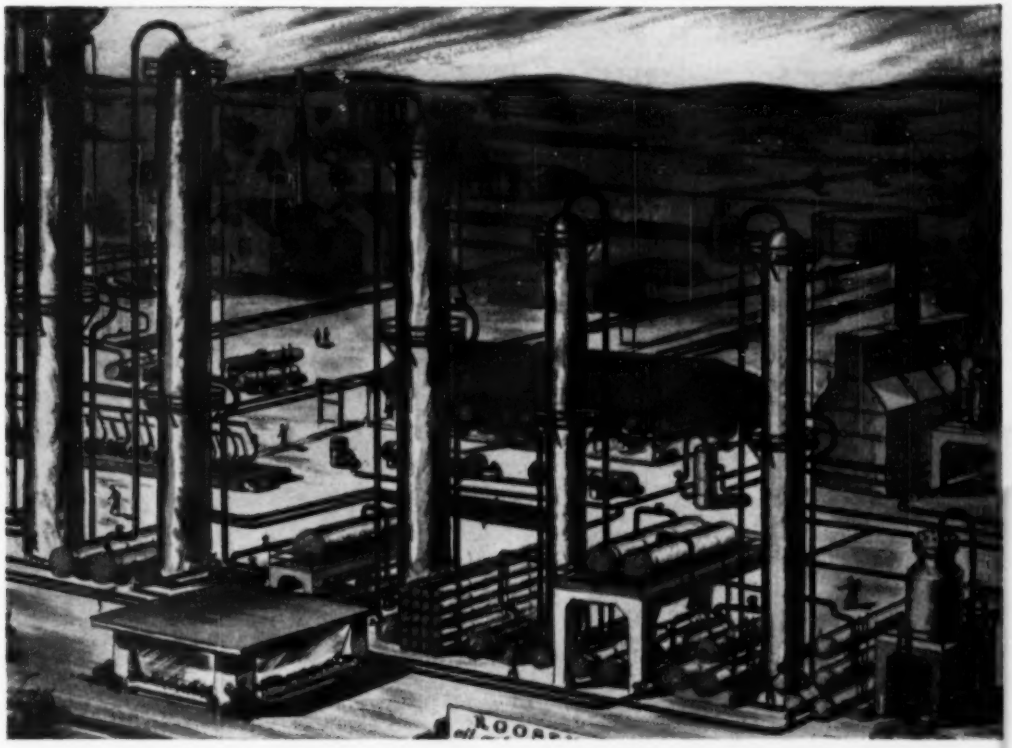
DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT



YOU *get the dividends from this $2,000,000 investment*

Here's an artist's sketch of $2,000,000 worth of equipment that means better products for you. Roosevelt's new platforming equipment is designed to deliver even higher quality solvents and naphthas to you and the hundreds of other manufacturers throughout the Mid-West.

It's another extra dividend you get, as a user of Roosevelt solvents. What are the others? Here are just two: complete catalytic sulphur removal which means non-corrosive, chemically stable solvents, free of offensive odors; and quick delivery to you by truck-transport and tank car quantities from the company geographically located to serve you faster.

Perhaps the aliphatic Naphtha you need is "standard" at Roosevelt . . . if it isn't we'll make it to meet your exact specifications.

Write for your copy of Roosevelt's book of specifications. It's yours for the asking.

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WORTH OF ACTHAR

in this "Piggy Bank"

You're looking at $2,000,000 worth of Armour-developed Adrenocorticotropic Hormone miracle drug, popularly known as ACTHAR. The "bank" is a transparent p-k Twin Shell Dry Blender.

Blending is the last of twenty operations which Armour performs on the pea-sized anterior lobes of hog pituitaries. To insure exact day-to-day uniformity of product characteristics, a "bank" of about $2,000,000 worth of ACTHAR is kept in the Twin Shell Blender at all times. To this is added each day's production. The contents are thoroughly blended. Shipments are taken from the blended mix.

This special p-k Twin Shell Dry Blender was engineered to meet Armour's exacting specifications. It is dust-tight, gentle, non-contaminating, and the finished blend is absolutely uniform.

Simply Designed for Better Blending

p-k Twin Shell Dry Blenders of transparent plastic are available in 1, 2, and 3 cu. ft. capacity. Sizes range up to 250 cu. ft. capacity in steel and other metals.

For full particulars on both the laboratory and production models, write for Catalogs 401 and 402.

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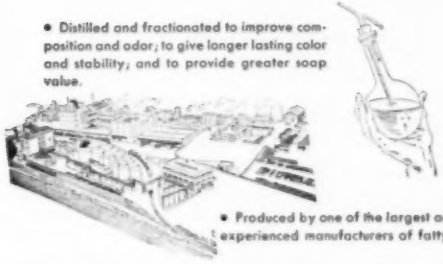
Many have tried and more will try to imitate the composition, color, stability and freedom from odor of Drew Coconut Fatty Acids.

Invariably, lack of specialized knowledge and experience make these imitations fall short of the real thing. Drew's many years of close study of fatty acids, plus modern research and production techniques, give you a product *plus* in Drew Coconut Fatty Acids that is unmatched by imitations.

DREW COCONUT FATTY ACIDS SET THE STANDARD

• Distilled and fractionated to improve composition and odor; to give longer lasting color and stability; and to provide greater soap value.



• Produced by one of the largest and most experienced manufacturers of fatty acids.

• Specified by name wherever government specifications call for highest quality fatty acids.

If *quality* has made your product famous . . . if you want to establish *quality* in your product . . . don't be satisfied with imitations. Always specify *Drew Coconut Fatty Acids.*

Write for Free Reference Booklet, "Drew Fatty Acids"

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Heavy Duty HAMMERMILLS for INDUSTRIAL USE

Reduce ANIMAL • MINERAL • VEGETABLE MATTER

CHEMICALS, SOAP CHIPS, ETC.
Many dry chemicals are being ground with Williams Heavy Duty Hammermills. Capacity is unusually high and power involved and maintenance extremely low.

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Such material, easily ground for use as animal food, whether it is expeller cake or hydraulic press cake.

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Hundreds of installations are daily proving our claims for better and more satisfactory reduction of such materials as — cracklings, tankage, fish scrap, raw and dry bones, etc.

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Standard machines are available for the reduction of practically every material. Capacities range from 50 to 600,000 lbs. per hour.

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Submit your grinding problems to Williams. A sample of the material and description of the desired result will set our facilities to work on a solution to your problem. Visits during test runs and technical consultations are invited.

WC-50-1

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DRIVES *for every power transmission need...*

Whatever your requirements in enclosed gear drives, you will find the one best suited to your needs in the complete Foote Bros. line.

Here are compact gearmotor and speed reduction units, ideal for use on original equipment. Heavy duty worm gear drives designed to stand up under tough service. Helical gear drives available in capacities of over 1500 h.p.

The latest in gear-cutting equipment, newest manufacturing techniques, better control of material—all backed by nearly a century of experience—assure you high quality enclosed gear drives.

Bulletins are available on drives to meet every need. Check the ones you want on the coupon below.

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Economical in original cost and operation. Duti-Rated Gears have file-hard tooth surfaces and ductile cores, assuring long life. Double or triple reductions, with ratios from 5 to 1 up to 238 to 1 and capacity range from 1 up to 175 horsepower.

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Heavy duty drives with precision worm gearing that assures high efficiency and load-carrying capacity. Horizontal, vertical and Hytop (extended shaft) types. Ratios from 4½ to 1 up to 4108 to 1. Capacities up to 260 horsepower.

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Heavy-duty helical gear drives. Available in single reduction units, ratios up to 9.91 to 1; capacities up to 1550 horsepower; double-reduction units, ratios from 9.32 up to 71 to 1, capacities to 1100 horsepower; triple reduction units, ratios from 79 up to 360 to 1, capacities up to 420 horsepower.

WORM-HELICAL GEAR DRIVES

Heavy duty vertical drives with horizontal input shafts and vertical output shafts—up or down. Ratios from approximately 25 to 285 to 1 and a capacity range up to 128 horsepower.

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Better Power Transmission Through Better Gears

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- ☐ Bulletin LPB Line-O-Power Straight Line Drives
- ☐ Bulletin MPB Maxi-Power Helical Gear Drives
- ☐ Bulletin GMA Foote Bros—Louis Allis Gearmotors
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City.....*Zone*.....*State*.....

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MEETS ALL STANDARDS *of the American Standards Association, the A.I.E.E. and the Acoustical Society of America*

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LOW TEMPERATURE and HUMIDITY EFFECTS — *readings independent of both under normal conditions (within 1 db)*

NON-DIRECTIONAL CRYSTAL MICROPHONE

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MANY ACCESSORIES AVAILABLE — *a-c operated power supply for long-time operation; special microphones for high fidelity measurements, for reproducible standards and for use at end of long cable; Octave-Band Noise Analyzer for use with the Type 1551-A Sound-Level Meter for simple and rapid analysis of noise with complex spectrum; Sound-Level Calibrator for making over-all acoustic check of complete instrument; Vibration Pickup and Control Box for vibration measurements down to 20 cycles.*

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CONVENIENTLY

with GR Sound-Level Equipment

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To Protect Persons Working Near Noisy Equipment

To Improve Working Conditions of Office Personnel

To Assist in Design and Construction of Buildings Housing Noisy Machinery

To Improve Performance of Industrial Equipment and Household Appliances

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J RENEWABLE SELF-ALIGNING GUIDES
10 SEAT RINGS EASILY REPLACED WITH VALVE IN PIPE LINE

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DOUBLE SEATED DIAPHRAGM CONTROL VALVES

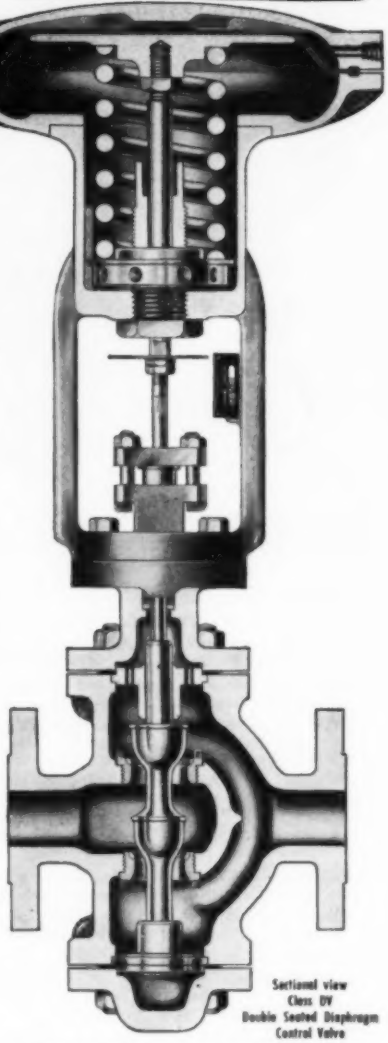
Calling a spade a spade you've got a "royal flush" of features in these new Valves designed for use with control instruments.

Their "Flow-Line" Contoured Bodies have ISA standard face-to-face dimensions and high capacity, low turbulence and minimum body pressure drop characteristics.

A new type, top and bottom guided construction is self-aligning and non-binding regardless of uneveness of bolt tightening.

Standard, integral stellited seating surfaces are recommended for steam service to reduce seat ring thread corrosion. Renewable, interchangeable seat rings also furnished where desired and may be easily replaced without removing valve body from the line. Elaborate grinding at high temperatures is completely eliminated.

With these Valves, you get as *standard equipment*, features heretofore only obtainable in expensive, specially designed valves.



Sectional view
Class DV
Double Seated Diaphragm
Control Valve

Look for LESLIE REGULATORS under "Valves" or "Regulators" in your classified telephone directory in the following cities where LESLIE factory trained engineers are located:

Albany, N. Y.	Chicago, Ill.	Galveston, Tex.	Memphis, Tenn.	Orlando, Fla.	Salt Lake City, Utah
Albuquerque, N. M.	Cincinnati, Ohio	Greenville, S. C.	Miami Springs, Fla.	Philadelphia, Pa.	San Francisco, Calif.
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Baltimore, Md.	Dallas, Texas	Indianapolis, Ind.	Minneapolis, Minn.	Ponca City, Okla.	St. Louis, Mo.
Beaumont, Tex.	Denver, Colo.	Kansas City, Mo.	Mobile, Ala.	Providence, R. I.	Syracuse, N. Y.
Birmingham, Ala.	Des Moines, Ia.	Kingsport, Tenn.	Monroe, La.	Richmond, Va.	Tucson, Ariz.
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***WRITE FOR* Bulletin 513**

ESTABLISHED 1900
LESLIE CO.

279 Grant Avenue, Lyndhurst, New Jersey

1707

FLOATLESS LEVEL CONTROLS • PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
SELF CLEANING STRAINERS • PUMP GOVERNORS • TEMPERATURE REGULATORS
• AIR HORNS • STEAM WHISTLES

Where Conduit dies young

For those locations in your processing where conduit lines are falling apart from corrosive vapors in only a few months, here's the answer . . .

ELECTRUNITE "Dekoron-Coated" E.M.T. is the light-and-strong rigid steel raceway with the plastic armor that resists attack by everything from hydrofluoric acid fumes to meat-plant atmospheres. Your electric lines are protected from moisture, fire, mechanical injury, AND from frequent costly shutdowns while corroded conduit is replaced.

Electricians find ELECTRUNITE "Dekoron-Coated" E.M.T. easy to install . . . no special tools, no special fittings, no special techniques. Even the couplings and fittings are quickly protected with tape of the same plastic that armors the galvanized steel E.M.T. It's *real* end-to-end corrosion protection.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
224 EAST 131st STREET • CLEVELAND 8, OHIO

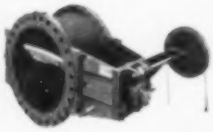
Write for literature describing ELECTRUNITE "Dekoron-Coated" E.M.T. It may help you put an end to costly periodic raceway replacement in your worst corrosion areas.

Republic
ELECTRUNITE
"Dekoron-Coated" E.M.T.
REPUBLIC STEEL

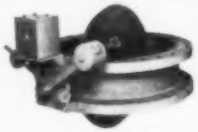
LIGHTWEIGHT THREADLESS RIGID STEEL RACEWAY

R-S valvEvents

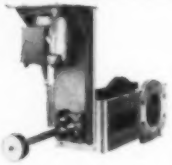
• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



WATER SERVICE—No. 825—36-inch 125-pound cast iron valve equipped with 18—6 shafts, bronze bushings and rubber seat for 85-pound drip tight shut-off.

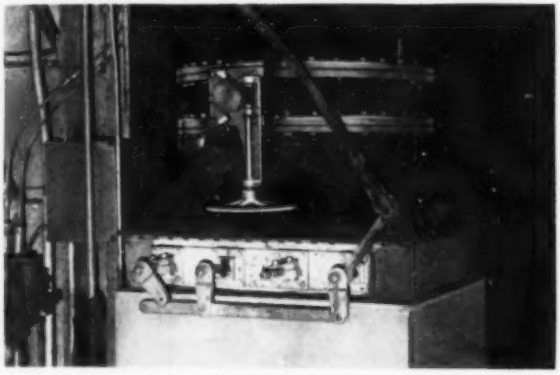


EMERGENCY OIL SERVICE—No. 628—solenoid trip valve. Should the solenoid function, the latch is tripped which causes the counter-weight to open or close the valve by gravity. Available in any metal or alloy and in various sizes for emergency shut-off or vent for air, gas, steam, oil, and water.



700° F. EXHAUST GAS SERVICE—No. 826—6-inch 125-pound R-S "H" metal valve used on small turbine generator. Equipped with 18—8 shafts, hastelloy bushings, finned lubricated stuffing box and solenoid trip mechanism.

STEAM SERVICE—No. 677—1500-pound welding end steel valve for superheated steam—A. S. M. E. Standards.



SEMI-SOLID SERVICE including abrasive and corrosive materials.

R-S VALVES
Control and Shut Off Practically Any Material

The beveled vane seats firmly at a 12½° angle and is closed from a fully open position through 77½° of arc by either manual or automatic operation. A metal-to-metal seat gives satisfactory commercial shut-off. When required, Monel or stainless steel can be welded to the vane periphery and a babbitted seat used in the valve body. Drip tight or bubble tight closure can be obtained with a rubber seat.

Power controlled prime movers delivering the necessary foot pounds of torque open or close these self-cleaning valves at any desired speed from one second to eight minutes according to requirements. Pressures range from 2 to 2500 psig and temperatures from minus 300° F. to plus 2000° F.

Such simplicity of design, adaptability and operating ease are the reasons why R-S Valves can be installed to control and shut off the volume and pressure of any material that flows or is forced through a pipe.

Obtain full details from your R-S representative.

R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.
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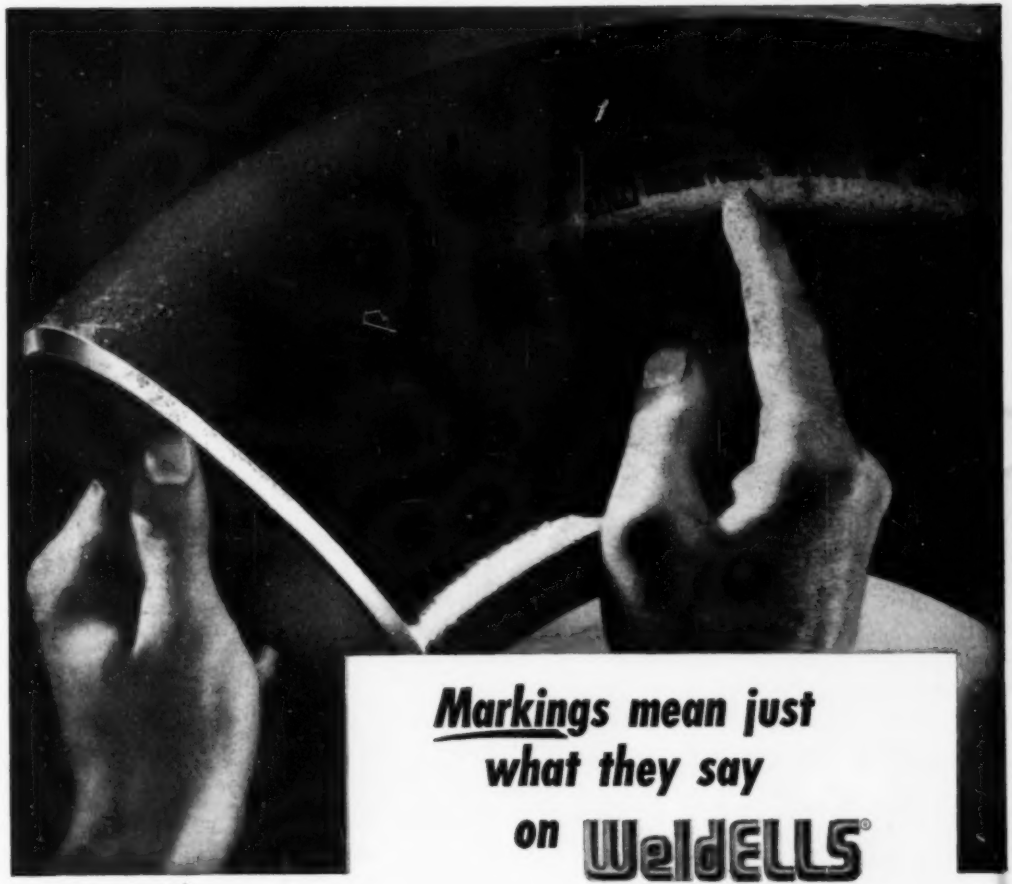

Markings mean just what they say on WeldELLS®

A VOLUME OF USEFUL DATA ON A SINGLE SHEET—Sizes, thicknesses and dimensions of all commonly used WeldELLS and Taylor Forged Steel Flanges ingeniously condensed on a heavy durable, letter-sized card. Indispensable for piping men. Coupon brings free copy.

No other fittings for pipe welding are so true to their markings as WeldELLS — so absolutely uniform, mechanically, metallurgically, dimensionally.

It would be bad business for us to say this if thousands of users had not already said it for us and to us. "There are no bad ones" is nearly always the foremost reason given by practical men for insisting on WeldELLS.

Pick up any WeldELL and check it against the tabulation of its size, wall thickness, and other dimensions. It will be right on the head. And it will be right on the head in plus-value features, too—features that are combined in no other fittings.

Remember that the finest line of welding fittings is also the broadest line. Coupon brings your copy of useful data described below.

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General Offices and Works: P. O. Box 485, Chicago 90, Ill.
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Please send a copy of your data sheet covering Taylor Forge Welding Fittings and Forged Steel Flanges.

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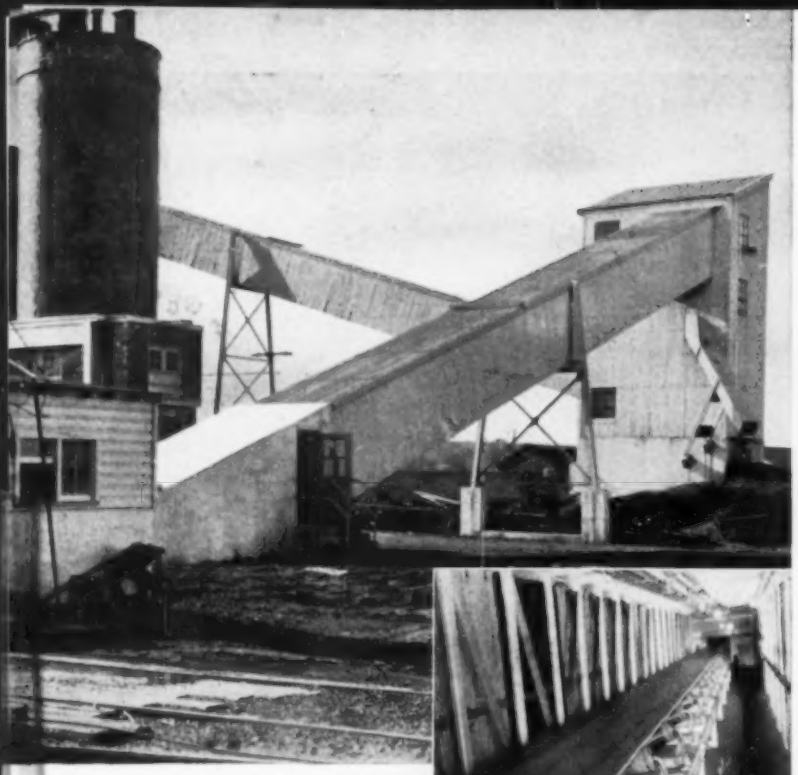

Starts fast at forty below...

This belt conveyor carries coal from railroad cars to overhead hoppers for a power company located in the northern part of the Midwest . . . so far north that temperatures frequently hit forty below zero. Starting the conveyor in that kind of weather meant lost time, wasted manpower. The bearing lubricant became so stiff that five or six men often were required to pull on the belt. Three hours a day frequently were lost in getting the unit in operation.

As many as a dozen conventional lubricants were tried without success before a change to STANOLITH Grease No. 42 was made on the recommendation of a Standard Oil lubrication specialist. None could match the ability of STANOLITH to provide easy starting at extreme low temperatures, and still maintain effective lubrication during high summer temperatures.

STANOLITH Greases are filling the bill in a wide range of industrial and processing applications because of their resistance to heat and to the washing action of water, and their ability to flow readily under wide variations in temperature. A Standard Oil lubrication specialist can help you take advantage of these special properties. A call to your local Standard Oil Company office is all that's necessary. Or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANOLITH
TRADE MARK
Greases

What's your problem?

Meet R. R. Rowlands, of Standard's La Crosse office. He is the lubrication specialist who worked with this power company to find the right grease for an especially tough job. And as a result of his work, the company was able to save considerable time in the operation of a coal conveyor.

His on-the-job service is typical of that available to all midwest plants through a corps of such lubrication specialists. You can be sure that the specialist in your own area has both the practical experience and the training in a Standard Oil Lubrication Engineering School that will result in dependable, thorough assistance.

Why not call your local Standard Oil Company office today? Put a lubrication specialist to work on your problem now. When he calls, be sure to discuss the advantages and performance records of these outstanding products:

STANOL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in air compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

CALUMET Viscous Lubricants—These greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of open gears and chains, better internal lubrication of wire ropes.

STANDARD OIL COMPANY **STANDARD** *(Indiana)*

HELPING TO CUT AMERICA'S *Death Rate*

PLASMA EXPANDER

STREPTOMYCIN

PENICILLIN

AS A RESULT of broad experience in the organic and inorganic chemical field, the Badger Process Division of Stone & Webster Engineering Corporation has made and is making significant contributions in the large scale production of life-saving pharmaceuticals.

Working currently for Commercial Solvents Corporation and General Aniline & Film Corporation, we are helping make it possible for these clients to produce in quantity synthetic expanders for blood plasma. These products do not take the place of blood plasma, but save lives by temporarily sustaining shock victims until they reach a hospital where the blood plasma is available.

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BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS (GREAT BRITAIN) LTD.

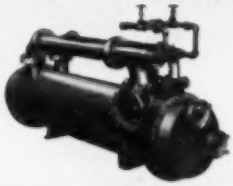
For suction pressures down to .002" (50 microns)

YOU CAN SAVE

operating and upkeep costs WITH I-R STEAM-JET EJECTORS

Single-stage ejector with direct-contact type aftercondenser.

Two-stage, single-element ejector with direct-contact type intercondenser.

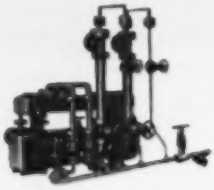


Single-stage, twin-element ejector mounted on surface-type precooler and aftercondenser.

Large booster-type ejector, similar to smaller sizes except with multiple one-piece steam nozzles and welded construction.

Three-stage ejector with direct-contact type intercondensers.

Two-stage, single-element, non-condensing ejector.



Two-stage, twin-element ejector with surface-type intercondenser and aftercondenser.

Whatever the capacity—whatever the gases or vapors to be handled—Ingersoll-Rand steam-jet ejectors can generally do the job far more economically than any other type of equipment. Their utter simplicity of design and operation assures long life and sustained high efficiency, with practically no maintenance at all.

Suction pressure is obtained by a steam-jet discharging into a specially formed suction chamber and venturi-shaped diffuser. That's all there is to it. There are no moving parts to wear out—no excessive noise—no vibration. Ejectors can be installed anywhere, with little or no foundation, and can be operated by inexperienced personnel.

Single-stage, two-stage and multi-stage ejectors can be supplied in any required combination—with pre-coolers, intercondensers and aftercondensers to meet the specialized needs of practically any application for suction pressures down to 50 microns (.002" Hg absolute).

Ingersoll-Rand's unequalled experience in vacuum equipment—both steam-jet ejectors and reciprocating pumps—is your assurance of impartial service in meeting your low-pressure requirements. For further information, contact your nearest I-R representative, or write for a free copy of Bulletin 9013A.

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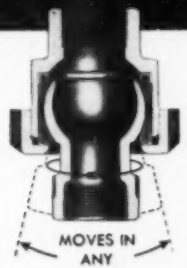
COMPRESSORS • AIR TOOLS • ROCK DRILLS
TURBO-BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS
DIESEL & GAS ENGINES

BARCO



1. **MAXIMUM FLEXIBILITY.** Up to 40° side flexibility with 360° rotating movement.
2. **CHEMICALLY INERT GASKETS.** Barco offers a choice of seven types of gaskets including No. 11-CT for corrosive service. No lubrication required.
3. **NO METAL-TO-METAL CONTACT BETWEEN MOVING PARTS.** An important Barco advantage where corrosive chemicals are present, either externally or internally.
4. **STAINLESS STEEL BODIES.** Also regularly furnished in Malleable Iron, Steel, Bronze, Aluminum, and Magnesium. Other special alloy joints to order.
5. **PRESSURE-SAFE! FIRE-PROOF!** Unequalled for SAFETY where flexible connections are required.
6. **MANY STYLES AVAILABLE.** Angle or straight; threaded or flanged connections. For pressures to 6,000 psi; temperatures to 1000°F. 15 different sizes, ¼" to 12".

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OF BULLETIN No. 215

Flexible BALL JOINTS

— when you need movable joints in piping handling

CHEMICALS

THE above photograph shows BARCO BALL JOINTS used to provide flexibility in Nitric Acid Tank Car Loading Lines at the Joliet, Ill., Arsenal. This is but one of many installations in the chemical industry where Barco joints are used to allow movement in piping conveying acids, alkalies, and solvents — as well as steam, air, oil, gas, or water.

BARCO BALL JOINTS offer many advantages over ordinary types of joints or flexible connections. When you want to be sure of getting SAFE, long-lasting, trouble-free installations, specify BARCO! Ask our engineers for recommendations. Worldwide Sales and Service. BARCO MANUFACTURING Co., 1816E Winnemac Ave., Chicago 40, Illinois. *In Canada:* The Holden Co., Ltd., Montreal.

BARCO

THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING, AND REVOLVING JOINTS

THE SURE WAY TO
CUT HOT WATER *Costs!*

Pick INSTANTANEOUS WATER HEATERS

TO PROVIDE
ANY VOLUME OF WATER
AT THE TEMPERATURE REQUIRED!

Here's the money-saving answer to hot water required for industrial needs. PICK Heaters provide hot water *instantly* — by steam injection. They're entirely automatic to provide and accurately maintain temperatures up to 180° F. The exclusive Pressurizer Piston stabilizes injection pressure — eliminates pipe hammering and shaking. Available in seven sizes with rated capacities of 10 to 200 gallons per minute. Greater volumes can be obtained by multiple installations. Installation is simple, requiring only ordinary pipe connections.

NO STORAGE TANKS NEEDED
Compact design permits installation in corners, on walls or overhead.

EASILY CLEANED
No coils. Can be cleaned in a matter of minutes — without dismantling.

Proved
BY PERFORMANCE IN
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GAYCO Separators, equipped with the adjustable centrifugal sizing fan—an exclusive GAYCO feature—make closer separations. Closer separations bring about higher production through efficient removal of the fines made by the mill. Closer separations bring about higher quality products by eliminating all undesirable oversize.

"TIMKEN GEARING EQUIPPED"
GAYCO brings you all these:

Range 60 to 400 mesh
Greater capacity 25 to 30% greater production
Cleaner Tailings
Uniform Products
Slow speed for slow wear
Quick and easy adjustments

If you have an exceptionally hard separating problem
TRY THE GAYCO

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For any problem concerning these or any other filtration application, write—wire or call Micro Metallic for prompt service

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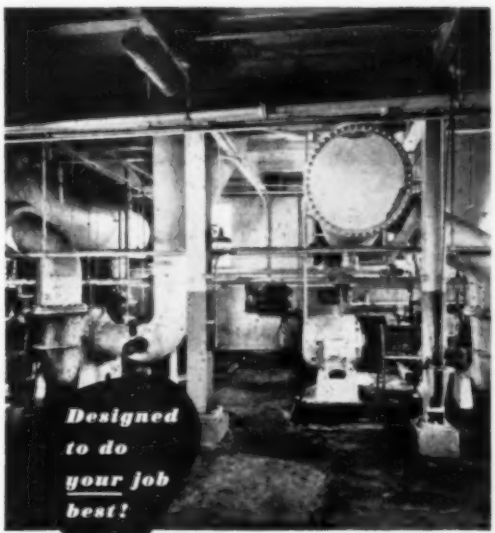
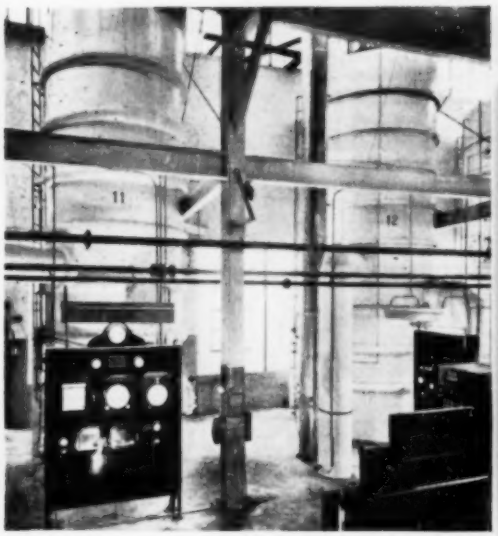
SEA CLIFF AVENUE, GLEN COVE, N. Y.

See General American for

CREATIVE EVAPORATOR ENGINEERING

Reduce scale deposits . . . Boost production with Conkey forced circulation horizontal tube evaporators





Liquids that tend to "scale up" need not push down your production. The Conkey forced circulation horizontal tube evaporator circulates large volumes of liquid at high velocities—through submerged and flooded tubes. In many cases, this scrubbing action is sufficient to greatly retard coating of tubes, even eliminating the scaling problem entirely.

Top production with top economies are assured by Conkey's unique design. A far smaller heating surface is required because of the high heat transfer coefficients obtained by forced circulation.

Whatever your special concentration problem may be, consult General American. Each installation is designed, engineered and built to fit your specific needs. Evaporators are built in a wide range of weldable metals. When required, special metals to resist corrosion, erosion and contamination can be furnished. Get technical bulletin on evaporators for your files.

Other General American Equipment:
Turbo-Mixers, Dewaterers, Filters, Dryers, Towers, Tanks, Bins, Pressure Vessels

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PROCESS EQUIPMENT DIVISION GENERAL AMERICAN TRADE MARK

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All These Were Once DUST COLLECTION PROBLEMS, TOO

48 Carbon Black Plants
203 Metallurgical Installations
205 Acid Plants
40 Paper Mills
270 Delarring Installations
216 Power Stations
73 Steel Plants
99 Oil Refineries and Miscellaneous Installations

Your electrical precipitator installation will be individually engineered . . . and based on the Research Corporation's *experience* graphically shown by that towering pile of thousands of blueprints.

This knowledge is a valuable asset that will help Research engineers "tailor-make" your Cottrell installation. For example, they can more quickly determine the right answers to such variables as the size, shape and type of both discharge and collecting electrodes, their relative spacing, flue arrangements and many other factors. At Research you can count on *profitable solutions to individual problems.*

Typical One Day Collections

6 TONS OF SODA SALT AT A PAPER MILL

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250 TONS OF FLY ASH

10 TONS OF ARSENIC

In one chemical plant, for example, a Research Corporation Cottrell collects 5500 pounds of concentrated sulphuric acid every day. An informative booklet gives valuable information on this and other chemical plant installations. Write for your free copy.

RC-117

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For full information on BUILDERS EQUIPMENT for metering and controlling flow of liquids, steam, or dry materials, write Builders-Providence, Inc. (Division of Builders Iron Foundry), 458 Harris Ave., Providence 1, Rhode Island.

BUILDERS-PROVIDENCE

LUBRICATION ECONOMY

"LUBRIPLATE saved us $2,098.16 in seven months"

The BROWN COMPANY, Quality Paper Makers of Berlin, New Hampshire, said this in an operating report on one of their Kraft Mill Lime Kilns after changing over from conventional oil lubrication to LUBRIPLATE No. 130AA. Huge savings like this cannot be overlooked. It is worth your while to see what LUBRIPLATE Lubrication can save you.

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2. LUBRIPLATE prevents rust and corrosion
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Write today for case histories of savings made through the use of LUBRIPLATE in your industry.

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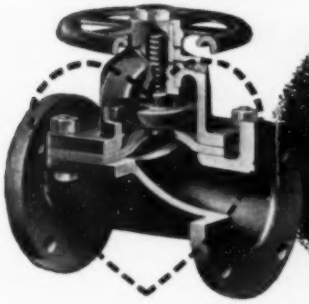
DEALERS EVERYWHERE. consult your Classified Telephone Book

for the heart of the Saunders Patent Valve . . .



Hills-McCanna offers a complete selection of diaphragm materials to best suit your individual requirements

Code Number	Base	Stock Type	Service Quality
R-1	Rubber	Carbon Black	Acid/Alkaline, Heat Resistant
R-2	Rubber	Non-Carbon Black	High Acid/Alkaline Resistant
R-3	Rubber	Carbon Black	Non-Fat Food Service
R-4	Rubber	Carbon Black	Special Non-Contaminating
R-5	Rubber	Non-Carbon Black	Acid/Alkaline, Abrasion Resistant
N-1	Neoprene	Carbon Black	Acid/Alkaline/Oil/Heat Resistant
N-2	Neoprene	Carbon Black	Fat Food Service, Non-Contaminating
N-3	Neoprene	White	Special Non-Contaminating
H-1	Hycar	Carbon Black	Acid/Oil/Heat Resistant
K-1	Butyl	Carbon Black	Acid/Heat Resistant
T-1	Tygon	Carbon Black	Acid Resistant
C-3	Compar	Carbon Black	Solvent Resistant
L-1	Special Polyethylene	White	Acid Resistant (66° Be Sulfuric)
M-1-25	Kel-F	Non-Carbon Black	High Acid/Alkaline Resistant

IN over 15 years of supplying Saunders Patent Diaphragm Valves to the processing industries, we have developed an extensive background of experience in the recommendation of the proper diaphragm material to meet a given set of conditions. This experience proves that only with diaphragms especially selected for your needs can you get the *best* service from your diaphragm valves. The wide range of diaphragm materials and their basic characteristics are shown in the table above. Each of these has advantages and limitations—no one is a cure-all—and the secret of successful selection of the right diaphragm is a thorough knowledge of these advantages and limitations.

Here at Hills-McCanna, recorded in the service records, is the experience that has resulted from valving over 2500 substances. This data is constantly being brought up to date to take into consideration the development of new diaphragm materials such as polyethylene and Kel-F. To any user of Hills-McCanna Valves, this record assures you of having the knowledge gained from thousands of other installations working for you.

Whatever your valving requirements, if they involve handling corrosive substances, slurries, semi-solids or other hard-to-handle fluids, we would welcome the opportunity to go over your needs with you. Hills-McCanna Diaphragm Valves are available in sizes from ⅜" to 14" handwheel or lever operated or arranged for automatic or remote operation. Choice of 14 diaphragm materials, 48 body materials. Write for descriptive literature. HILLS-McCANNA CO., 3025 N. Western Ave., Chicago 18, Illinois.

HILLS-McCANNA

saunders patent

diaphragm valves

Also manufacturers of Proportioning Pumps
Force Feed Lubricators • Magnesium Alloy Castings

Only Koncentrik
STAINLESS STEEL FITTINGS

STOP DANGEROUS LEAKS

...with Patented Floating Seat

1 Double sealing, self-centering seat is Teflon reinforced to eliminate line losses.
2 Heavy duty, fatigue-proof constructed for high pressure use.
3 Easy to install. No special tools needed.
4 Economical . . . because parts are interchangeable and reusable.
5 Complete line for tubes to 1" O.D., and for Schedule 5 S and 10 S tubing to ¾". Other sizes to order.

THE SPECIAL SCREW PRODUCTS CO.
5445 Dunham Rd., Bedford, Ohio

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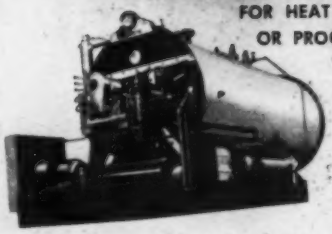
Descriptive literature and performance data available upon request. Write today.

STEAM

FOR HEAT OR PROCESS



A complete steam plant backed by undivided responsibility • Shipped completely assembled • More than 80% thermal efficiency guaranteed • 4-pass design provides 5 sq. ft. of heating surface per b.h.p. • Built-in induced draft eliminates need of expensive chimney • Simple installation • Clean, quiet operation • Heavy-duty construction assures long-lived dependability

Superior Steam Generators are manufactured in 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i. or for hot water heating.

For complete details, write for Catalog 322

SUPERIOR COMBUSTION INDUSTRIES

Factory: Emmaus, Pa.

Exec. Offices: Times Bldg., Times Sq., New York N. Y.

Superior STEAM GENERATORS

heart of the strainer

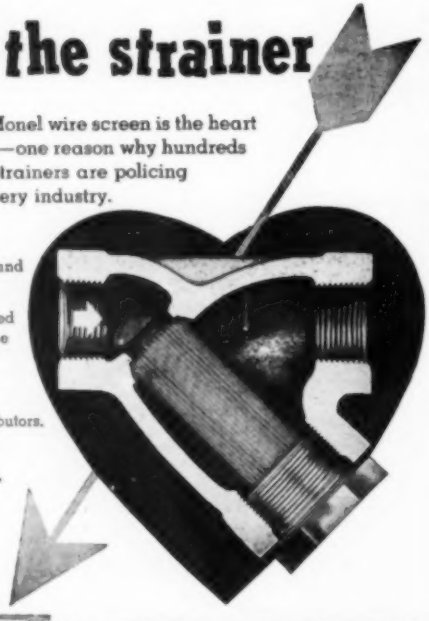
A high-grade, woven Monel wire screen is the heart of the Yarway Strainer—one reason why hundreds of thousands of these strainers are policing pipe lines in nearly every industry.

OTHER REASONS—

- cadmium plated bodies and screen caps
- straight threads, machined faces and spark-plug-type gaskets on screen caps
- ten sizes from ¼" to 3"

Sold by 216 industrial distributors. Write for Bulletin S-203.

YARNALL-WARING CO.
137 Mermaid Ave.
Philadelphia 18, Pa.



YARWAY STRAINERS

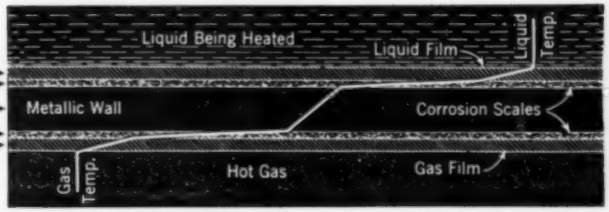
(His business paper . . . of course)

With the pushing pace of business today, your business problems won't wait. That's why many of the **Best Informed Men in your Field** take their business papers home to read. Competition won't stand still. New products come so fast you've *got* to keep up with every issue. You need the news of what's new and what's happening . . . the what-to-do-and-how and what-to-do-it-with, in *both* editorial and advertising pages. They keep *you* one of the **Best Informed Men in your Field.**

CHEMICAL ENGINEERING

One of a series of ads prepared by
THE ASSOCIATED BUSINESS PUBLICATIONS

Can you figure all the walls in heat exchange?

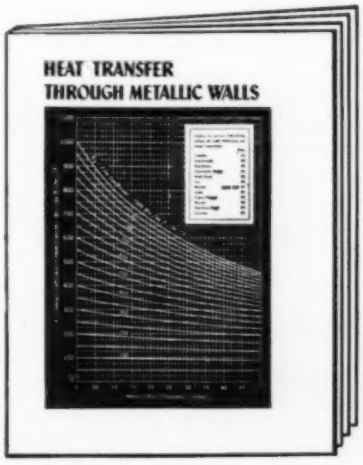


Add *two* unknowns to the heat transfer rate of a metal – and what do you get?

You get the problem that faces a designer trying to calculate the true performance of a proposed heat exchanger.

The rate of heat movement through a metal itself–of any thickness–is easily determined. But the effect of the gas or liquid films that will adjoin the metal wall is difficult to predict. And even more uncertain and more damaging, is the scale or oxide layer that forms on the metal surfaces.

The nature of the scale layer – its thickness, density, and chemical composition, is governed by conditions that vary in each case. But the insulating, or interfering, nature of the scale layer is tremendous.



Engineers are fast learning to hold scaling difficulties to a minimum–through the selection of metal. Nickel and high-Nickel alloys are among the preferred metals because of their resistance to scale formation.

Nickel forms a very thin, tough, oxide layer for self-protection. This layer is so thin it is often invisible. *But*, this thin layer prevents a buildup of more oxide, protects the metal against corrosive attack that would form other coatings.

The mechanical properties of Nickel alloys give high resistance to erosion or pitting from gas, steam, or liquid. Its strength and toughness also permit *thinner* walls, resulting in *faster* heat transfer.

INCO has issued a booklet–HEAT TRANSFER THROUGH METALLIC WALLS–that contains invaluable information on heat exchange performance of many metals. A copy of this bulletin will be sent free on request.

And if you have a specific heat transfer problem – the solution may be one of the INCO Nickel alloys. Because these alloys are on extended delivery, however, it will pay you to anticipate your needs. *Order well in advance giving necessary N. P. A. ratings with complete end use information.* And remember, INCO's Corrosion Engineering Section is always glad to help you with your special corrosion problems. Just write, giving full details.

The International Nickel Company, Inc.
67 Wall Street, New York 5, N. Y.

You're looking at a polished section cut from a Duraspun Centrifugal Casting...a casting with 12-14% chromium. It tells better than words of the high quality of Duraspun Centrifugal Castings.

You get a fine, dense, uniform grain structure. Possible air pockets and blow holes are eliminated. Tensile strength is higher than with static castings.

Order Duraspun if you need pipe or tubing. Sizes run up to 15 feet in length; up to 32 inches OD; and down to ¼ inch wall thickness. Odd shaped pieces can be produced providing a circular hole passes uniformly down the center. These, of course, require specially designed casting forms.

If, before ordering or asking us to quote, you would like to know more about our work and facilities, send for our Catalog 3150.

THE DURALOY COMPANY

Office and Plant: Scottdale, Pa. • Eastern Office: 12 East 41st Street, New York 17, N.Y.

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Chicago: F. O. NELSON 332 S. Michigan Avenue
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METAL GOODS CORP., Dallas • Denver • Houston • Kansas City • New Orleans • St. Louis • Tulsa

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Advertising

Advertising men agree—to do a complete advertising job you need the double effect of both Display Advertising and Direct Mail.

Display Advertising keeps your name before the public and builds prestige.

Direct Mail supplements your Display Advertising. It pin-points your message right to the executive you want to reach—the person who buys or influences the purchases.

More and more companies are constantly increasing their use of Direct Mail because it does a job that no other form of advertising will do.

McGraw-Hill has a special Direct Mail Service that permits the use of McGraw-Hill lists for mailings. Our names give complete coverage in all the industries served by McGraw-Hill publications—gives your message the undivided personal attention of the top-notch executives in the industrial firms. They put you in direct touch with the men who make policy decisions..

In view of present day difficulties in maintaining your own mailing lists, our efficient personalized service is particularly important in securing the comprehensive market coverage you need and want.

Ask for more detailed information today. You'll be surprised at the low over-all cost and the tested effectiveness of these hand-picked selections.

McGRAW-HILL PUBLISHING CO., INC.
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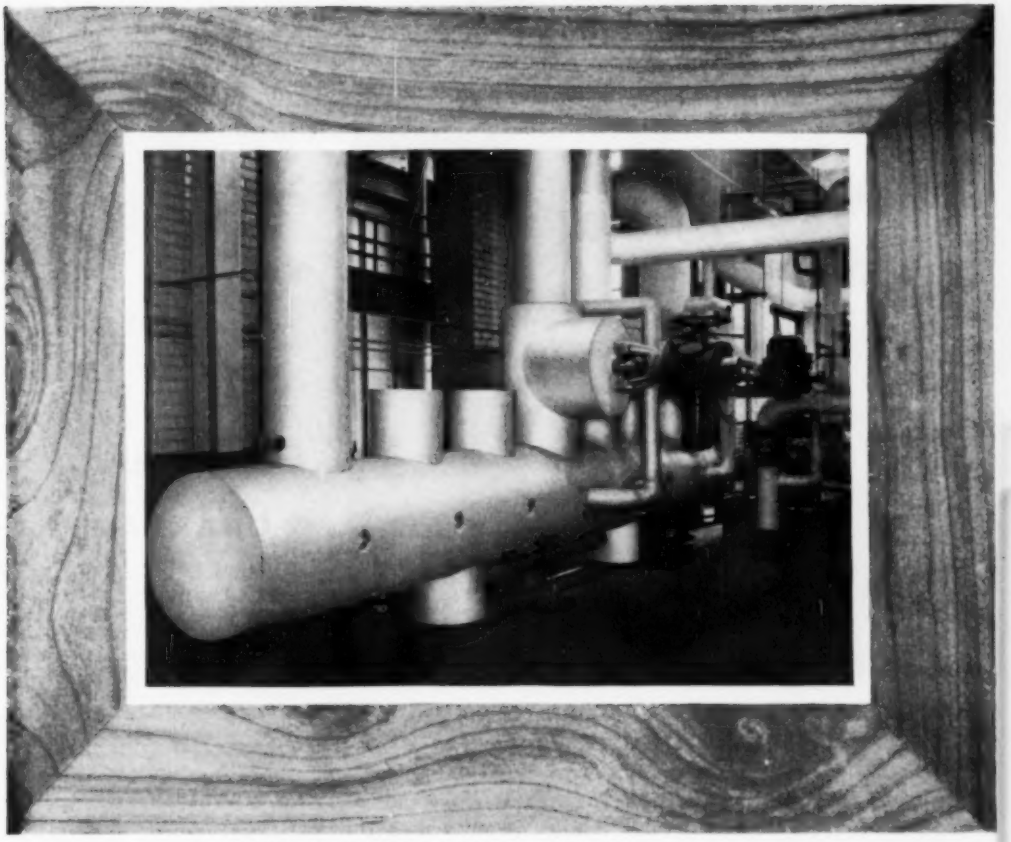


Insulation Contractor: Guy M. Beaty & Co., Charlotte, N.C.

Steam header at Cannon Mills Co., Kannapolis, N.C., insulated with K&M Hy-Temp and "Featherweight" 85% Magnesia Combination, finished with sewed canvas jacket.

PORTRAIT OF STEAM HEADER AT 750° F.

clothed for life . . . . with K&M Insulations

YOU SEE here one of the most efficient combinations you can get today for lifetime protection against heat loss—K&M Hy-Temp Insulation teamed up with "Featherweight" 85% Magnesia.

You can use the same combination, in appropriate thicknesses, for efficient insulation of temperatures from 600° F. up to 1900° F.

K&M Hy-Temp Insulation is applied directly to the high temperature surface in sufficient thickness to lower the temperature of the outer surface of the insulation to 600° F. or less. "Featherweight" 85% Magnesia, which has a higher insulating value, is then applied directly over the Hy-Temp Insulation, thus utilizing the advantages of both insulations to the fullest extent.

These insulations are supplied in appropriate forms and thicknesses for application to equipment surfaces and piping.

Your local K&M distributor, who is an experienced applicator, will give you full information. Or write us direct . . . we'll rush a reply.

Nature made Asbestos . . .

Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

"More Capacity from Existing Equipment?"

we use

ACID-PROOF TANTALUM

Heat Transfer Equipment

"One of our problems was to add more capacity to sulphuric acid concentrator equipment. Even if we had space for them, it would take months to build more concentrators. By installing tantalum bayonet heaters and using higher steam pressures, we got the desired additional output. In some cases, concentrator capacity was increased 300 per cent."

TANTALUM BAYONET HEATER used in Simonson-Mantius concentrator for H_2SO_4 recovery. More than 250 bayonet heaters have been made for this use. The first, installed in 1945, is still in service.

USE TANTALUM WITH ECONOMY for most acid solutions, corrosive gases or vapors; not with HF, alkalis, or substances containing free SO_3.

Acid-Proof TANTALUM

22403C

Fansteel Metallurgical Corporation NORTH CHICAGO, ILLINOIS, U.S.A.

CAUGHT IN A Coil QUANDARY?

May we help you with your coil problems? Whitlock is fully equipped to (1) Coil tube up to 6" or bend pipe up to 30" . . . in any lengths. (2) Assemble and test hydrostatically up to 20,000 psi. or up to 3500 psi. by "air under water". (3) Heat-treat and stress-relieve as required. (4) Furnish coils in place within tanks or pressure vessels. (5) Fabricate a wide range of materials (as indicated in the illustrations).

For information on Whitlock Heat Transfer Equipment, write for illustrated Bulletin No. 945. The Whitlock Manufacturing Co., 94 South Street, Hartford 10, Connecticut.

WHITLOCK

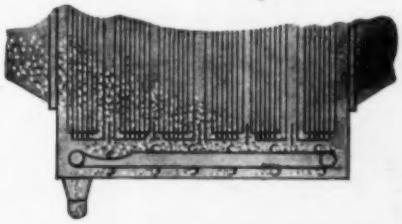
DESIGNS and BUILDS Boilers • Coils • Condensers • Coolers • Heat Exchangers • Heaters • Piping • Pressure Vessels • Receivers • Reboilers

Let's be practical about precipitators

1

This Koppers "packaged" mechanical or vacuum tube power pack is not restricted to an area near the precipitator. It can easily be installed in any convenient place in the plant. Result: Compact designs! More flexibility!

2



This Koppers exclusive—the bottom drag scraper —provides continuous dust removal. Cumbersome hoppers are eliminated and dust handling is simplified. Result: Lower operating costs! Less space requirement!

Here are two ways Koppers engineers simplify precipitator operation for you!

PERFORMANCE GUARANTEED!

Koppers engineers protect your investment in an electrostatic precipitator by guaranteeing both the recovery or gas-cleaning *efficiency* and the *residual content* left in the gas after cleaning. Koppers-Elex electrostatic precipitators are designed, engineered, fabricated, erected and guaranteed *under one contract* by Koppers Company, Inc.

IN ADDITION to high efficiency, Koppers concentrates on the practical aspects of electrostatic precipitator design. Shown above are just two of the many practical features which simplify operation.

Besides these compact power packs and the continuous dust removal features, Koppers-Elex electrostatic precipitators may be of the multiple-chamber type. This means one chamber may be shut down for inspection or maintenance without stopping the gas-cleaning action. The dirty gas is simply diverted through other chambers where cleaning continues.

Because rapping is *sectionalized*, re-entrainment is minimized. And because successive collection fields can be separately *energized*, maximum voltage can be applied to each field—with higher gas-cleaning efficiency resulting. Pressure drops are negligible.

IF YOU HAVE A GAS-CLEANING PROBLEM, write and outline the details for us to review. There is no obligation. Just address your letter to: KOPPERS COMPANY, INC., *Precipitator Dept.*, 214 Scott Street, Baltimore 3, Maryland.

KOPPERS

Koppers-Elex ELECTROSTATIC PRECIPITATORS

A&N PLATINUM

GOLD AND SILVER

for the chemical + metallurgical industries

Electrodes, Stills, Retorts and other Special Process Equipment to order.

Laboratory Wares of all description. Sheet, Wire, Tubing, Gauze and Fine Foils.

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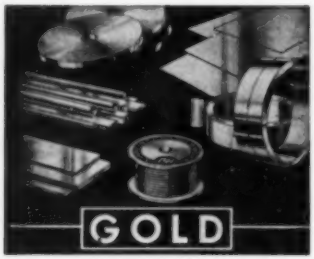
Platinum Metal Catalysts — Concentrated forms and on carriers.

Palladium, Iridium, Osmium, Rhodium and Ruthenium.

We pay highest prices for scrap platinum and have facilities for prompt recovery of spent platinum and palladium catalysts.



Sheet, Foil and Ribbon, pure and in alloy. Seamless Tubing. Laboratory Apparatus and Process Equipment.
Karat Golds. Fine Gold Anodes.

Fine, Sterling and Coin. Sheet, Wire, Circles and Foil.
Fine Silver Anodes. Rolled, Cast or in Shot forms.
Silver Brazing Alloys and Fluxes for every industrial requirement.

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C-20, *"Platinum, Gold and Silver for Science, Industry and the Arts"*
C-21, *"Platinum and Palladium Catalysts"*.

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PRECIOUS METALS SINCE 1875

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NOW AVAILABLE

Reprints of last month's Chemical Engineering Report

PUMPS

PURPOSE . . .

Here is an up-to-the-minute classification of all pumps, emphasizing the chemical pump — complete information.

WHAT'S IN IT . . .

Author R. E. Dolman discusses positive displacement, rotary, centrifugal, regenerative, mixed and axial flow, centrifugal jet and the centrifugal chemical pumps. He gives the latest information on the respective types, sizes, applications, advantages, disadvantages and materials of construction.

Dolman also gives a detailed list of the information you will need to select a pump in a chemical plant.

15 pages of pump facts, neatly outlined for quick reference. With 57 line drawings and charts. Ask for reprint P. Price 50¢. Send orders with remittance to:

CHEMICAL ENGINEERING
Attention: M. Molin
330 West 42nd St.
New York 36, N. Y.

41% More Output
With Faster Safer Lukenweld Driers

Sluggish drying slowing down your output? Here's a thought that may help.

A large eastern pharmaceutical manufacturer required faster flaked drying for the production of a well-known proprietary product. By replacing two drying units using conventional type drier rolls with units utilizing Lukenweld Jacketed Steel Drier Rolls, an average production boost of 41% was realized. Had higher pressures been used, the output "bonus" would have been even more impressive. Greatly reduced maintenance costs provided still further savings. For, despite the action of 30% saline solution, the chromium plating of these drier rolls has lasted over six years. Other type chromium plated rolls required refinishing every one and a half years.

If you have a job calling for roll drying, you can probably do it faster with Lukenweld Jacketed Steel Drier Rolls. Use of high strength rolled steel plate permits *safe* operation at pressures as high as 350 psi and higher. Restricting steam to a shallow annular jacket, Lukenweld design offers you faster heat-up . . . faster reflection of pressure variations . . . while installation costs are lower, maintenance minimized.

For information on Lukenweld flaking and drying and other processing machinery for the chemical field, write Lukenweld, Division of Lukens Steel Company, 400 Lukens Building, Coatesville, Pa.

Improved machinery for improved processes through engineering

LUKENWELD

LUKENS

A DIVISION OF LUKENS STEEL COMPANY

FROM HOMES...

TO SEWAGE DISPOSAL PLANTS

CHECK CORROSION FROM ACIDS AND ALKALIES LONGER WITH RUBBER-BASE (PARLON)® PAINTS

Rubber-base paint covers a multitude of maintenance problems—and solves them effectively. For home or industry—in fact, wherever a severe corrosion or weathering condition exists—maintenance experts rely more and more on the protective qualities inherent in paints with a chlorinated rubber base.

These fast-drying finishes seal and protect concrete, wood, and metal surfaces against corrosive solutions, temperature changes, and humidity. They resist acids, alkalies, fumes and salts three to four times longer than ordinary coatings—making them particularly advantageous for use in sewage disposal plants where acid constantly attacks ferrous metal and masonry.

Rubber-base paint is especially durable on concrete because of its resistance to abrasion and the free alkali in cement. Ask your paint supplier about easy-to-apply and economical-to-use rubber-base paint—or write direct for details.

HERCULES POWDER COMPANY
Cellulose Products Department
952 Market Street, Wilmington 99, Del.

CR52-2

for Rayon or Gold
Sugar or Penicillin

SHRIVER FILTER PRESSES give better filtration at lower cost

Whether it's rayon or furfural, silver or zinc, brewery mash or wine, colors, salts, glue, clays, oils or pharmaceuticals . . . or a host of other products that need improvement through filtration—you can bet a Shriver Filter Press will do more jobs for you, better, at lower over-all cost.

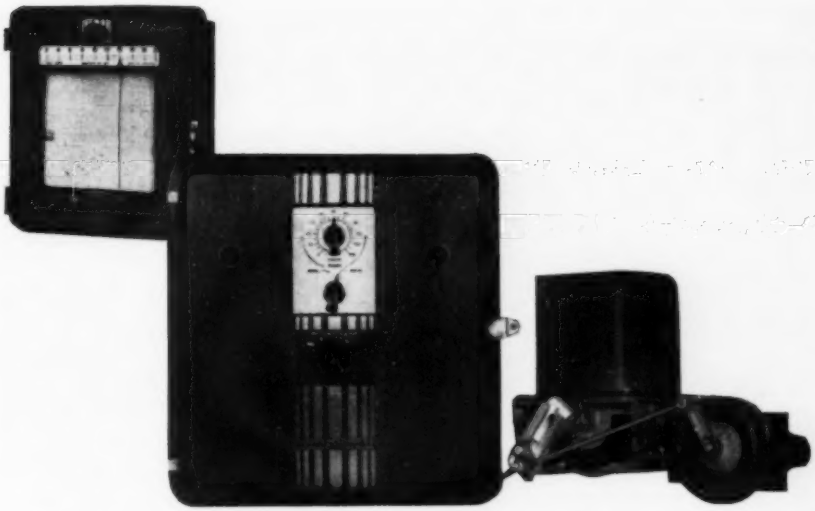
Straight Facts Prove Shriver Filter Presses

1—Are lowest in cost per sq. ft. of filtering area.
2—Filter, clarify, decolorize, bleach or deodorize liquids and recover, wash, extract, thicken, steam out, melt or redissolve desirable solids or waste materials.
3—Operate at any pressure or temperature.
4—May be made of any metal, wood or plastic.

Can you ask for more? Get all the facts straight. Get the new Shriver Catalog.

Write for Bulletin No. 126

T. SHRIVER & CO., Inc.
802 Hamilton St. · Harrison, N. J.



P.A.T. 50 is pyrometric control for increasing industrial production

With production demands reaching toward all-time highs, this new P.A.T. 50 Control comes at the ideal time to help thousands of firms increase industrial process output. Here's why:

This control has something that's brand new. It acts on the *speed* of swings in temperature as well as on their size and permanence. Thus, if temperature changes gently, it is gently nudged back into line. But if it starts off briskly, P.A.T. 50 reacts briskly. The faster the change, the further P.A.T. 50 moves the fuel valve. Then, at the instant this action begins to head off the change, the Control starts backing away. By putting on the brakes it brings temperature back into line smoothly, rapidly.

This *speed* response is "Rate Action", and P.A.T. 50 is the only electric positioning control which makes it available. It's one of L&N's unique contributions to automatic regulation.

Also, the familiar Proportioning & Reset Actions are even more responsive than before. They stop the normal, everyday temperature changes which are started by changes in the size or permanence of the heat load. These P.A.T. 50 actions now have more range of adjustment and sensitivity than ever before.

The resulting improvement in control shows up at all times, but especially when temperature is edging away from the control point, or leveling off incorrectly. P.A.T. 50 gives results far superior to any previous electric control.

The News Is In The Control Unit. Everything new in P.A.T. 50 is in the Control Unit (center picture) . . . which connects a Speedomax or Micromax Recording Controller to a fuel valve drive. Earlier P.A.T. Controls can be converted to P.A.T. 50 by replacing the unit and making slight changes in the controller. The new unit has no moving parts except two hermetically sealed relays.

For complete details, contact our nearest office, or write us at 4916 Stenton Ave., Philadelphia 44, Penna.

Shown here are just a few of the information sheets on P.A.T. 50 Control. The whole set is yours for the asking.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl Ad ND4-33(2)

25 YEARS OF LEADERSHIP IN FASTENINGS OF STAINLESS STEEL

To YOU, the 25th Anniversary of Anti-Corrosive is an assurance that when your requirements call for fastenings of stainless steel, you can *depend* on Anti-Corrosive to serve you best! Anti-Corrosive is the oldest, largest and best-known firm dealing exclusively in stainless steel fastenings . . . an enviable position in a fast-growing industry . . . your guarantee of product excellence!

Still Plenty of Fastenings IN STOCK

If you need quick delivery of stainless steel fastenings, check Anti-Corrosive first! Although most of our production requires D. O. Ratings, there is still a wide variety of stock items in our bins which may fit your needs . . . or, a suitable alternate ready for *immediate delivery* may be suggested!

FREE-A-N SELECTOR!

Write TODAY for handy Slide Chart No. 52D . . . instantly identifies A-N Nos. pertaining to stainless steel fastenings, gives sizes and other data. Free catalog also available.

Anti-Corrosive Metal Products Co., Inc. 1927–1952

Manufacturers of STAINLESS STEEL FASTENINGS

CASTLETON-ON-HUDSON, NEW YORK

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Reprints of the February Chemical Engineering Report

THE BATTLE FOR PRODUCTION

Chemical Engineering's 29th annual review and statistical issue. A survey of the chemical industry at the halfway mark in its huge program for putting up plants to turn out the goods for an arsenal economy.

Plants & Facilities
Expenditures, past and planned, for expanding capacity.

Processes & Technology
Normal growth and rearmament requirements spur production.

Mobilization
How Washington is grappling with shortages.

Labor & Manpower
The days of manpower austerity are arriving.

Profit & Loss
Chemical profits wilt as the tax bite grows bigger.

Supply & Demand
Slowly the gap between demand and supply is being closed.

48 pages of facts and figures to help you keep abreast of what has happened and what is happening in the chemical process industries. Ask for reprint B-186. Price $1. Send orders with remittance to:

Chemical Engineering
Attention: M. Molin
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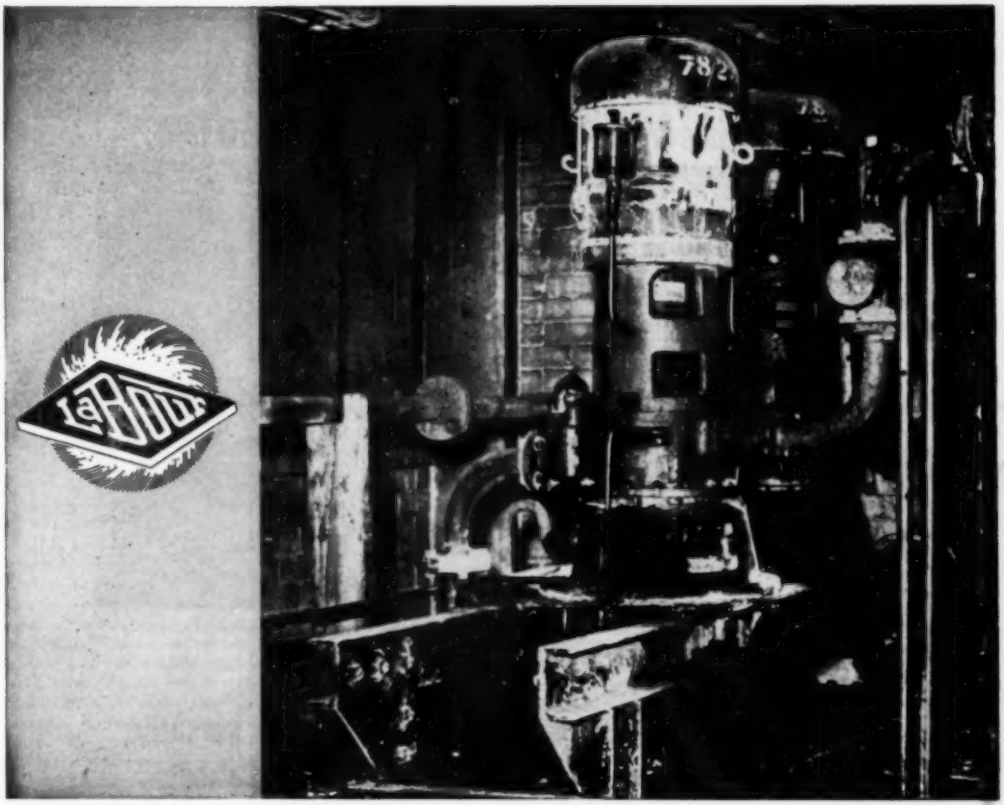

Universal Answer to Tough Jobs

For more than two years now, the LaBour Type G pumps pictured here have been on continuous 24 hour service handling 96% sulphuric acid at 65° C. They are operated in London, England, by that city's largest maker of sulphuric acid. These particular pumps were built in the British LaBour plant, under the same strict supervision and test policy followed in the U. S. LaBour operations.

All over the world, wherever chemical processes place severe service demands on pump equipment, experienced engineers prefer LaBour. With well over a quarter century of history now on record, LaBour pumps have universally demonstrated themselves as the best possible insurance against costly interruptions due to pump failure. If you are interested in true operating economy based on twenty-eight years of proof, ask us about LaBour pumps for your next job.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR

THE LABOUR COMPANY, INC. ★ Elkhart, Indiana, U.S.A.

CORRUGATED *Asbestos* TRANSITE*

FOR INDUSTRY

In this coke quencher station, Johns-Manville Corrugated Transite effectively withstands severe steam and fumes, and protects the structural steel framework.

FOR TRANSPORTATION

This hangar section is part of the largest structure ever built of Johns-Manville Corrugated Transite. The building is 80' high, 1000' wide and over 2000' long.

You build economically and quickly with these versatile fireproof and weatherproof asbestos building sheets

In the past quarter century, Johns-Manville Corrugated Transite has proven an ideal material for roofs and for sidewalls of industrial, commercial, institutional and agricultural buildings. Made of asbestos and cement, the large sheets are easy to handle, go up quickly with a minimum of framing. Practically indestructible, Corrugated Transite is fireproof, rotproof, weatherproof, needs no paint or special treatment to preserve it, and can be salvaged and re-used if necessary.

Today, Corrugated Asbestos Transite is also used increasingly for smart interiors . . . the streamlined corrugations and attractive shadow lines that give it such unusual architectural appeal for exteriors offer unlimited interior design possibilities.

Investigate J-M Corrugated Asbestos Transite and learn how you can build quickly and easily . . . have an attractive, long-lasting, trouble-free structure regardless of size or purpose. For complete details write Johns-Manville, Box 158, Dept. CE, New York 16, N.Y. In Canada write 199 Bay Street, Toronto, Canada.

*Reg. U. S. Pat. Off.

JM EASY TO FASTEN TO STEEL

EASY TO SAW

EASY TO DRILL

EASY TO NAIL TO WOOD

Johns-Manville *Asbestos* **CORRUGATED TRANSITE**

More Accurate Level Reading of LOW TEMPERATURE LIQUIDS . . .

JERGUSON

Large Chamber

NON-FROSTING* GAGES

YOU get the highest possible accuracy of reading on low temperature, low boiling point liquids with the patented Jerguson Non-Frosting Gage in the New Large Chamber model . . . because it insures less turbulence at the meniscus, and clear vision at the vision slot.

This new Jerguson model has 6 times larger area at the meniscus than the standard gage, so that there is a marked reduction in turbulence with light gaseous fluids that tend to boil or surge. Moreover, the problem of frosting encountered with these liquids has been eliminated by a patented frost preventing unit extending from the gage glass. This special transparent unit projects beyond the cover bolts and prevents frost from building up over the vision slot.

Here's a dual feature gage that assures greatly increased accuracy of reading for the process industries. If you have a problem with light gaseous fluids, or with gage frosting, it will pay you to investigate the new Jerguson Large Chamber Non-Frosting Gage . . . reflex or transparent.

Jerguson Large Chamber Gage, Transparent Type, with the patented Non-Frosting Gage Glass Extension. Write for literature on this gage, and on other non-frosting Jerguson models.

**Patented*

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

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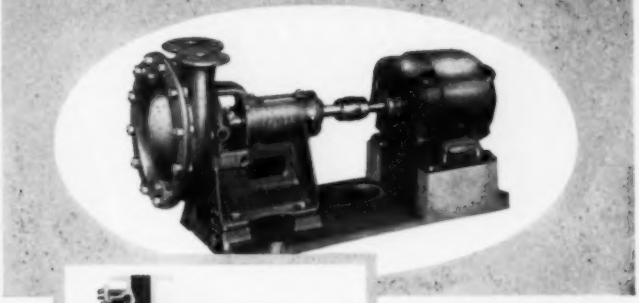
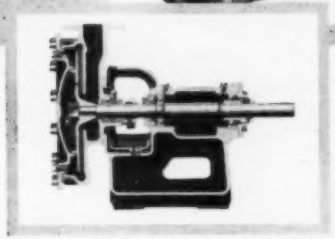
Representatives in Major Cities

Phone Listed Under JERGUSON

Jerguson Trees Gage & Valve Co. Ltd., London, Eng.

For economy in handling corrosive liquids . . .

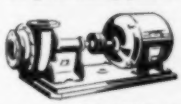




With the stuffing box on suction side of impeller, pressure on it is limited to the suction head only, assuring long packing life and freedom from excessive leakage. Interior of pump can be inspected and cleaned and impeller can be removed or replaced without disturbing the piping.

specify GOULDS stainless steel centrifugal PUMPS

Other GOULDS PUMPS for processing plants



This highly efficient Goulds single stage centrifugal pump (Fig. 3169) is well suited for general processing purposes. Ten sizes.

Nonclogging impeller of this vertical sump pump (3047) will handle water containing large solids or fibrous materials.

For capacities up to 15,000 G.P.M. Heads up to 500 ft. Check the specifications of this Goulds bail bearing double suction centrifugal (3450).

One plant engineer reports better than a seventy-five percent cost saving by handling an especially erosive slurry with Goulds Fig. 3705 Stainless Steel pumps. The pumps previously used not only cost almost four times as much as the Goulds pumps, but the Goulds pumps have already been in service over twice as long.

The entire fluid end of this Goulds Fig. 3705 pump is of stainless steel mounted on a cast iron support. It is regularly carried in stock in No. 316 and FA 20 stainless steels, but other metals and alloys can be supplied for all parts coming in contact with the liquid.

This pump has several features that contribute to economical, 24-hour service with acid and alkaline liquors which quickly corrode standard iron or bronze pumps. Bulletin 725.3 describes this Goulds unit in detail. We will be glad to send you a copy.

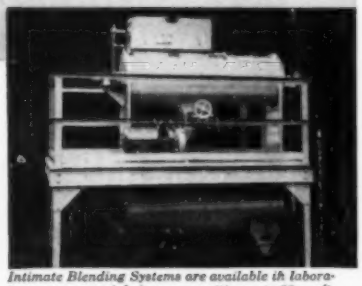
MEMBER

Goulds PUMPS INC.

Seneca Falls New York

all over the country (and abroad, too)

INTIMATE BLENDING EQUIPMENT —BY SPROUT-WALDRON DOES THE JOB!



Intimate Blending Systems are available in laboratory or commercial sizes...capacities up to 60 cu. ft.

Applications:
Agricultural Dusts • Brake Lining and Battery Case Formulas • Detergents • Dyes • Pigments, and many other fine powder blends.

SOUTH CAROLINA . . . "We are greatly pleased with the performance of our Sprout-Waldron Blending System. We believe without a doubt that the dust produced on our equipment surpasses anything else on the market in the South today. Producers of technical toxicants used by us agree with this opinion."

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GEORGIA . . . "Our production records show five distinct formulas totaling more than 450 tons were blended on our S-W equipment in the last three months, without any mechnical trouble whatsoever."

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PENNSYLVANIA . . . "Visiting representatives from Farm Co-ops in other states unanimously characterized our insecticide dusts as being the finest, most uniform blends they had ever examined."

Use the advice of Sprout-Waldron, Specialists in Intimate Blending, to improve your product . . . safeguard your personnel . . . step up production . . . and increase your profits. Write for Bulletin 1-846 today! Sprout-Waldron & Company, Inc., 15 Logan Street, Muncy, Pennsylvania.

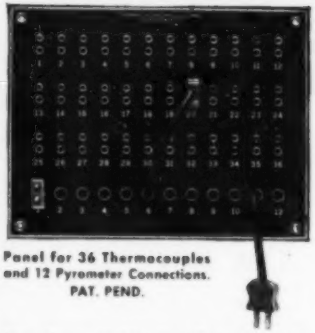
SW SINCE 1866

SPROUT-WALDRON

INTIMATE BLENDING

21

CONNECTING MANY THERMOCOUPLES?



Panel for 36 Thermocouples and 12 Pyrometer Connections. PAT. PEND.

Use these Quick Coupling Connector Panels to provide centralized control and a rapid and flexible system for switching multiple thermocouple circuits. Polarized Plugs and Jacks of calibrated thermocouple material connect numerous thermocouples to pyrometers—regardless of their location.

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HOW to choose a catalyst. The four requirements a catalyst must meet. Developing a catalyst: varying components, varying process conditions.

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TRIPLEX STAINLESS-STEEL HIGH PRESSURE PUMPS, AND COLLOID MILLS

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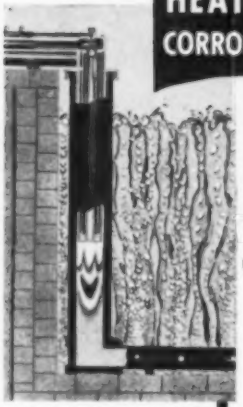
Submerged Combustion

DIRECT FIRED GAS BURNERS



Exposed view Submerged Combustion Burner as now used to concentrate calcium chloride and ferric chloride solutions.

- Flame burns below surface, bringing liquid quickly to heat.
- Hot exhaust gases forced through liquid carry away moisture.
- Installed in any type tank. No boiler room required. Use any type gas—natural or manufactured. Automatic in operation.
- For rapid evaporation and concentration of acids, salt solutions, suspensions. Also for heating water and solutions.

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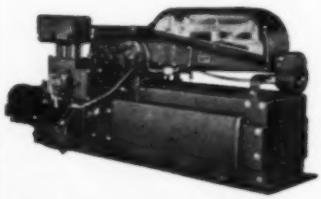

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M-15a

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PRODUCT CONTROL THROUGH *INFRARED ANALYSIS*

Number 6 *of a Series of Data Sheets for Better Process Control from The Perkin-Elmer Corporation, Manufacturers of Infrared Spectrometers, Flame Photometers and Electro-optical Instruments.*

PLANT:

Julius Hyman & Company,
Denver, Colorado.

PROBLEM:

Plant Production Control
Analyses for:

1–insecticide production units;
2–pilot plant operations;
3–specifications on incoming materials;
4–comparison of product-development with routine plant samples.

Also, a) determination of micro amounts of aldrin and dieldrin used in toxicological and field residue studies; b) checks on formulation samples, such as wettable powders or emulsions, made from products of normal production runs.

SOLUTION:

Infrared analyses using system of numbered, calibrated, sealed liquid absorption cells.

INSTRUMENTATION:

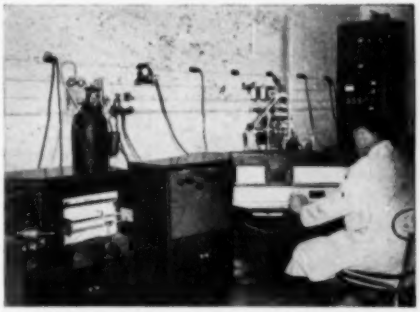
Two Perkin-Elmer Model 12-C Infrared Spectrometers; NaCl, KBr, LiF_2 optics; standard, sealed liquid absorption cells; 10 cm and 1-meter gas absorption cells; sealed liquid absorption microcells.

DISCUSSION:

Both instruments run 24 hours daily on 8-hour shifts. Operators are high school graduates with 3 months special training; they prepare samples, run analyses, calculate and record results. Also carry out mechanical maintenance. Breakdown time only 3%. Total of 4000–4500 analyses run per month. Instruments also used in research for obtaining pure spectra, correlation work and structural studies.

REFERENCE:

Determination of Micro Amounts of Aldrin and Dieldrin by Infrared Spectroscopy, Garhart, M.D., et al., Anal. Chem. (Submitted for publication.)



High school graduates operate Perkin-Elmer Model 12 Spectrometers on 24-hour basis at Julius Hyman & Company, Denver, Colorado.

Let us discuss your Product Control Problems with you.

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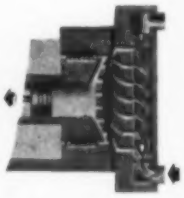
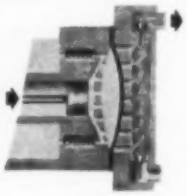
This 8-page quarterly brings you the latest developments in electro-optical instrumentation as well as their application to research and process control.



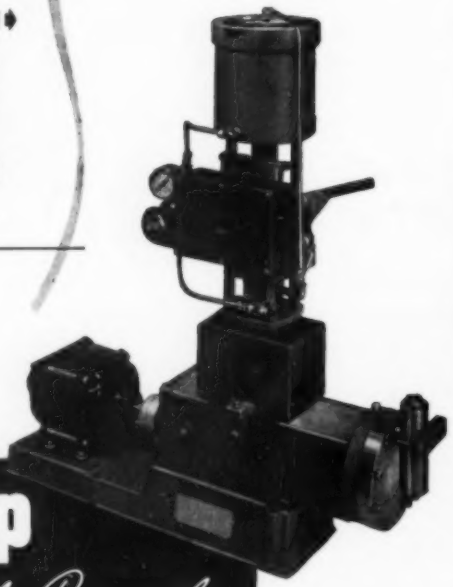
INTAKE STROKE



DISCHARGE STROKE

No Contamination

. . . and Positive control of pumping volume



Lapp

Auto-Pneumatic PULSAFEEDER

Reciprocating piston action provides positive displacement. But piston pumps only a hydraulic medium. Diaphragm does no mechanical work—acts only as floating, balanced partition, isolates chemical being pumped from working pump parts—eliminates need for stuffing box or running seal. Pumping speed constant—volume variation results from variation in piston-stroke length. In Auto-Pneumatic models, pumping rate precisely controlled by instrument air pressure responding to any instrument-measurable processing variable. The Lapp Pulsafeeder is successfully handling almost all highly corrosive and "hard-to-handle" chemicals, against pressures up to 2,000 lbs.

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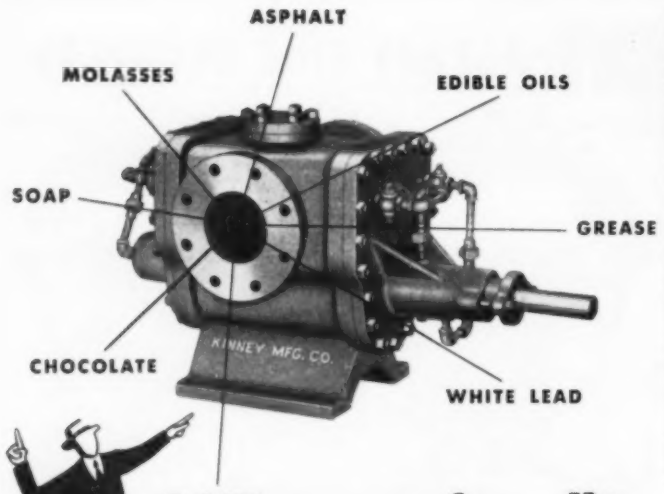

ONE pump for all!

This positive displacement pump is *right* for handling the widest range of viscous materials! It's the Kinney SD Rotating Plunger Pump — the one pump that's got the stamina to take heavy punishment . . . and *like* it.

VERSATILITY — Kinney SD Pump handles a wide variety of materials without adjustment. Steam-jacketed models are available in many sizes.

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My liquid pumping problem involves:

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☐ Asphalt	☐ Edible Oils	☐ Paint, Enamel	☐ White Lead
☐ Chocolate	☐ Fuel Oils, Diesel Oil	☐ Road Oil	☐ Others (see letter attached)
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Fig. F88

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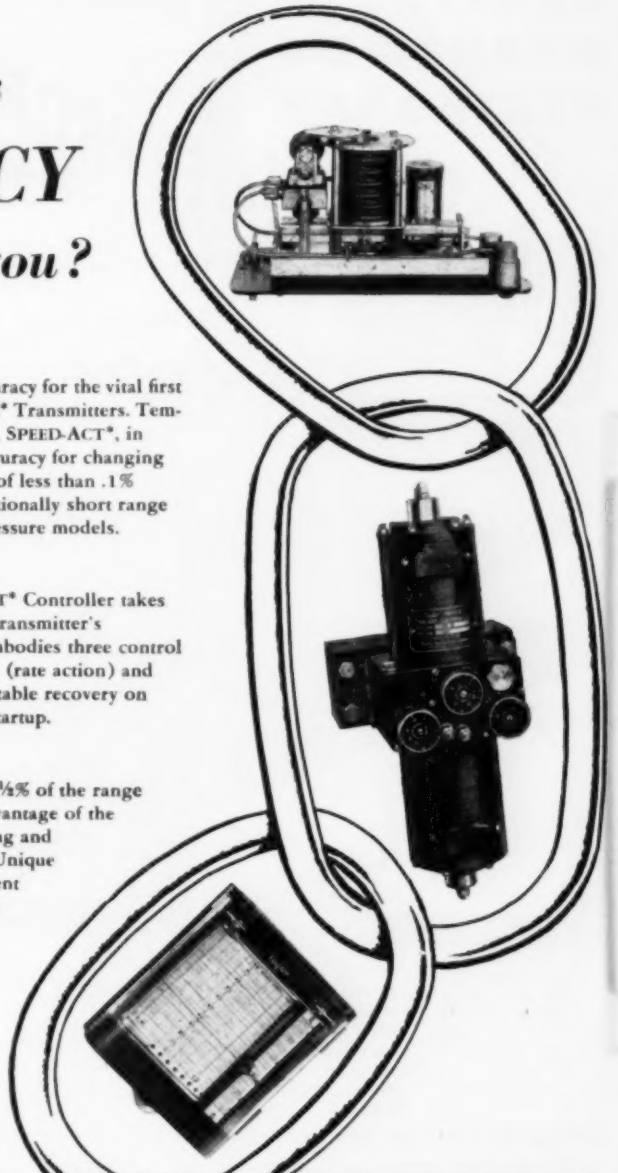

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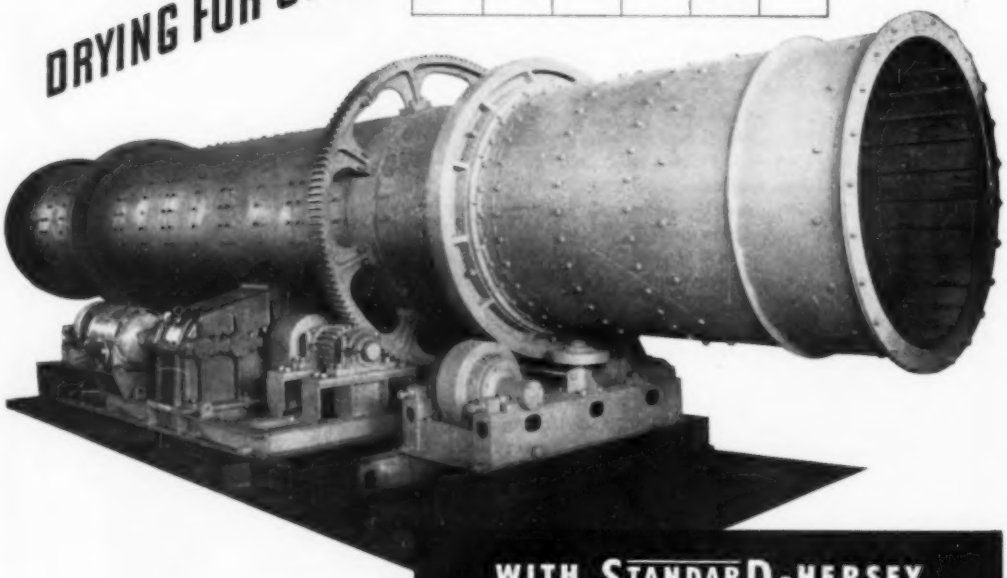

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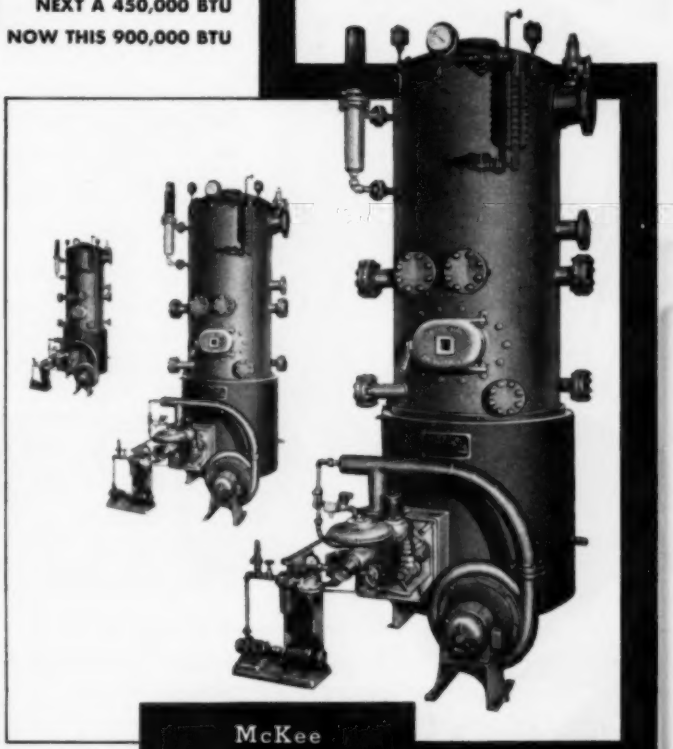

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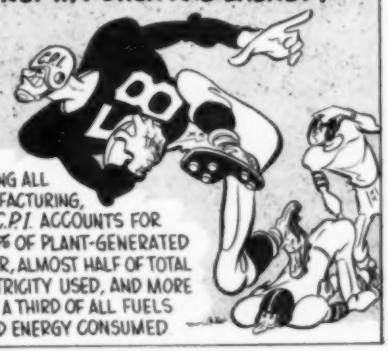

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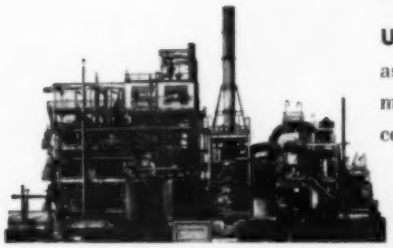

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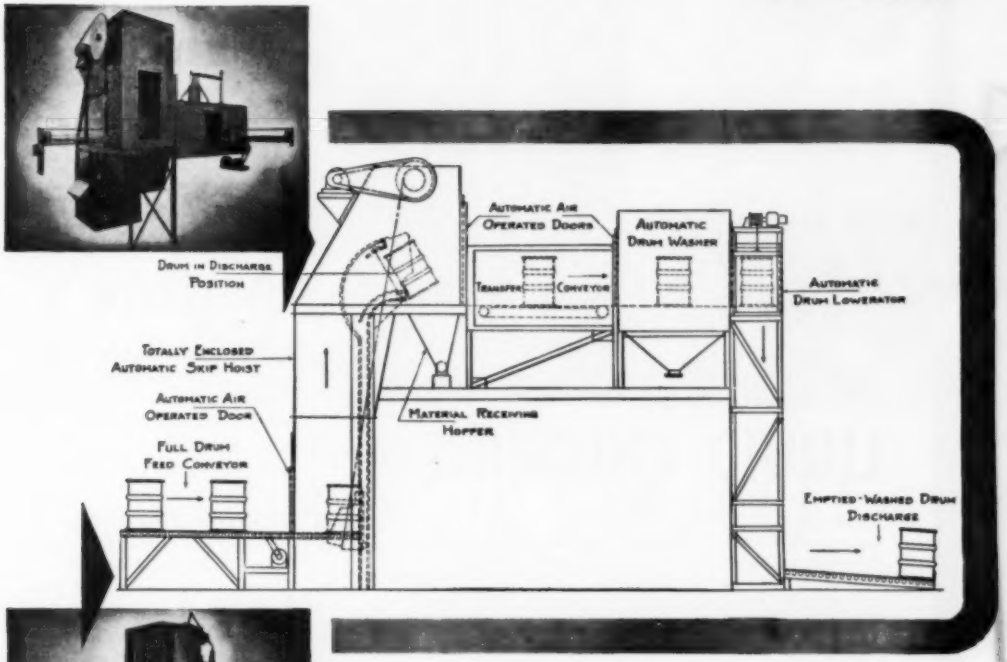

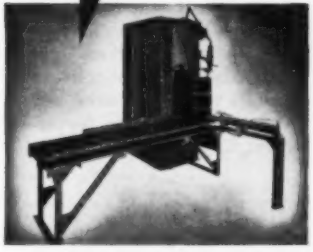

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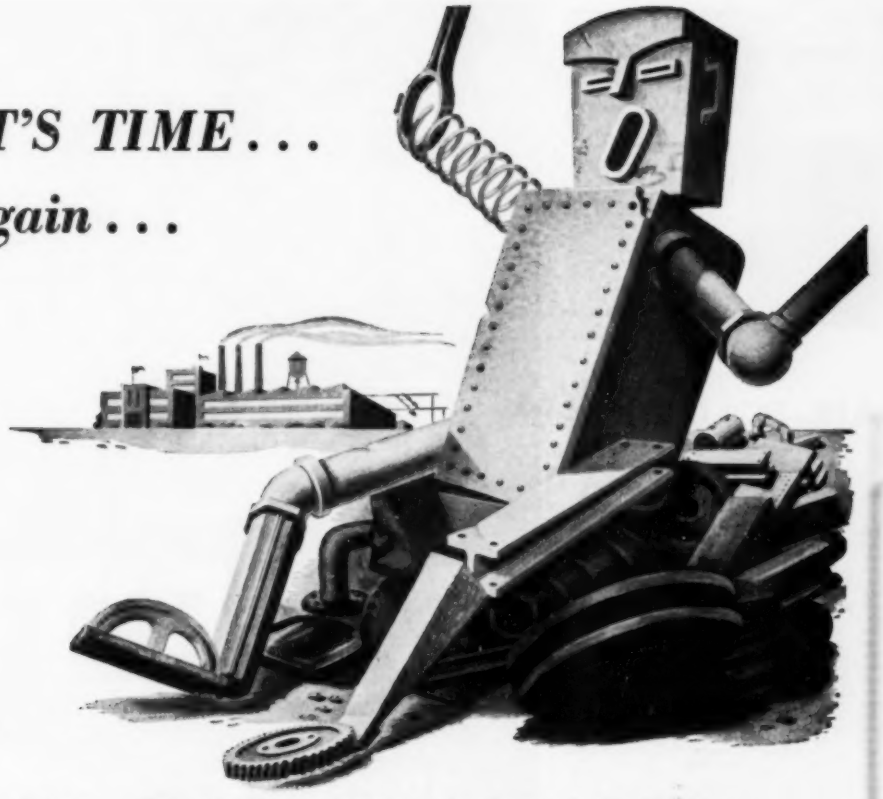

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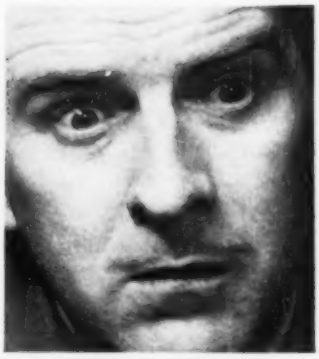

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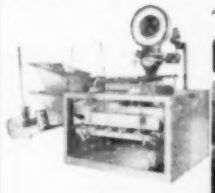

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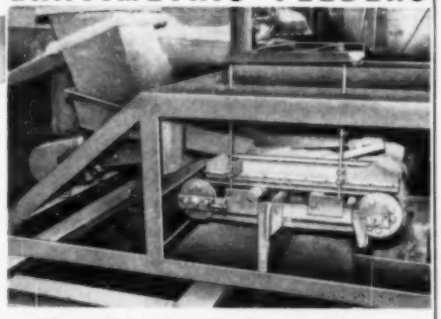

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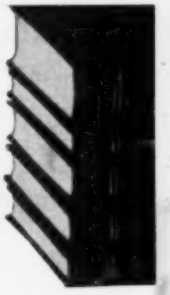

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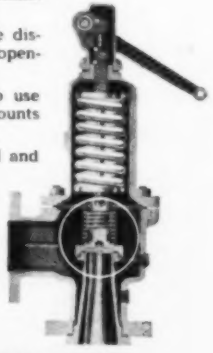

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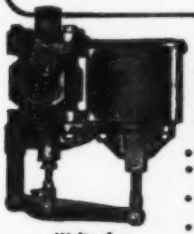

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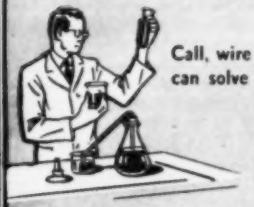

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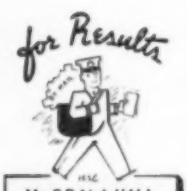

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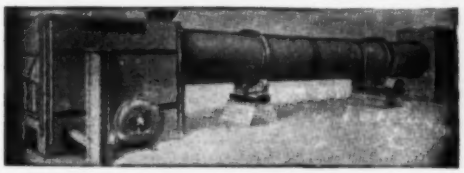

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(Continued on the following page)

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2—42" All STAINLESS STEEL Centrifugals. Amer. T&M Co. with S/S basket, curb, casing, shaft unloader and 40 H.P. variable speed Slip Ring 3/60/440 V 1200 RPM motor with full controls. Suspended bottom discharge type. Now at Newark.

1—Tolhurst susp. Centrifugal with perf. 40" MONEL basket. Bottom discharge, 2 speed, 20 h.p. 5 h.p., 3/60/440V Motor. All contact parts Monel. Still erected, can be seen in operation.

DRYERS

1—#705-20 Link Belt Roto Louvre Dryer.

1—7' x 45' Link Belt Rotary Kiln.

1—3' x 26' MONEL shell hot air Dryer, saw tooth flights, steam coils, etc.

1—5'6" x 24' Direct Heat Rotary Dryer or Rotary Kiln, welded shell.

1—7' x 70' Louisville Type L, Indirect-Direct Heat Rotary Dryer.

4—Buflovak 5' x 12' double drum Dryers.

1—Devine #7 Vacuum Shelf Dryer, 13 shelves 40 x 43.

2—Buflovak Double Drum Dryers 32' x 80" complete with stainless steel accessories.

1—Devine Rotary Vacuum Dryer, 2' x 8', also 5' x 25'.

2—Buflovak Vacuum Drum Dryers, 5' x 12' with all accessories.

1—6 x 30 Louisville welded shell Rotary Steam Tube Dryer with two rows, 54 tubes. Also two 6' x 27" Davenport same type, also 6' x 35' Louisville with stainless steel tubes.

3—J. P. Devine Double Door Vacuum Shelf Dryers; each equipped with 20 heated welded shelves, 30" x 78" pumps and condensers.

1—F. J. Stokes 14 shelf, 44" x 44" Vacuum Shelf Dryer with vacuum pump and condenser, etc.

2—5' x 40' Ruggles-Coles Direct Heat Rotary Dryers.

1—American 42" x 120" atmospheric double drum Dryer.

MIXERS

2—Read and Day 50 gal. double arm Mixers.

4—Baker Perkins, jack. Mixers, 3,000 gal., size 30, type X.

1—100 gal. jack. S.S. Mixer, heated blades.

1—Patterson 110 gal. S.S. Vacuum Kneadmaster.

1—AMF 340 qt. Glen Mixer, 2 S-S Bowls and beaters, md — new 1949 — practically new.

3—AMF 160 and 120 qt. Glen Mixers, 20 S-S 80 and 160 qt. bowls and beaters, md. new 1949 — practically new.

JACKETED KETTLES

3—1000 gal. Ptaudler, plain steel, jack.

1—1000 gal. Stainless Steel, jack. agit.

45—Aluminum & Stainless Steel 20 gal. to 150 gal.

1—500 gal. open agitated.

2—Lee 200 gal. S-S Kettles, 125#.

4—Burkhardt Copper, 275 gal.

1—Copper 600 gal. turbine agitated copper coils.

1—100 gal. and one 150 gal. Depp small C.I. dbl. motion agitated.

1—10' dia. x 4' Bartlett and Snow 1800 gallon, with agitator, 9/16" plate, 80 lbs.

1—300 gallon s/s jacketed kettles, 100 lbs. pressure, with cover and B. O.

MISCELLANEOUS

5—Lightning portable Agitators, 1—1½ H.P., s/s shafts.

4—Micro Pulverizers, Model 4TH, 24": #2SI, #2TH.

350—Stainless Steel Dryer Trays, 36" x 34" x 1½" deep.

1—Copper Rectifying Column, 6 sections, 30" dia x 33' high, bubble cap type.

15—Dry Powder Mixers and Blenders, rotary and horizontal ribbon type, 100 to 5000 lb.

1—Capem, S.I.F. Copper, cap feeder, m.d.

4—Swenson-Walker, jacketed, Crystallizers.

2—Buflovak 6' dia. vacuum Crystallizers.

1—Buflovak 6' dia. Atmos. Jack. Crystallizer.

1—6" x 15" Sturtevant Jaw Crusher to ½".

1—24" x 15" Sturtevant Crushing Rolls, balanced type.

1—5-Roll Raymond High Side Pulverizer.

8—Porcelain Lined Pebble Mills, 6' x 8' 800 gals., 5' x 4' 235 gals., 37" x 48" 100 gals.

2—8000 Gal. Horizontal Stainless Steel Storage Tanks #304 S/S lined, now equipped for mixing and also jacketed for steam or for cooling.

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CRCO New Way MH Wraparound Labeler.
S. & S. G1, G2 G6 Auger Fillers.
Stokes and Smith Model HG88 Duplex Auger Powder Filler.
Colton 2 & 3RP Rotary Tablet Machines.
Stokes 90D Tube Filler & Closer.
Stokes 2C Cream Filler and Closer.
Triangle Package Elec-Tri-Pak G2C, G2S, A2C, N2CA and A6CA Fillers.
Filler 4 Head Stainless Steel Filler.
Horix S. S. 14-head Rotary Filler.
Standard Knapp No. 429 Carton Sealer.
Mikro 4TH, 3TH, 1SH, Bantam Pulverizers; Jay Bee U1, Schutz O'Neill Mills.

3300 gal. working cap. Steam-Jacketed, Double-Arm Mixing Tanks for mixing, storing or processing of your materials.

Tri-Homo #6 S. S. Colloid Mill.
8. P. 150 gal. Unidor S. J. D. A. Mixer.
Stokes, Day, New Era, Hottman Mixers, from 2 to 450 gals., with and without Jackets, Single, Double Arm Agitators.

Robinson #4, 800 lb. S. S. Dry Powder Mixer, Sifter and Elevator.
Baker Perkins and Readco Heavy Duty 5 to 150 gals. Double Arm Jacketed Mixers with Sigma or Fish Tail Blades.
Ross, Day Pony Mixers, 8, 15 gal. caps.
Day, etc. 100 to 2500 lbs. Powder Mixers.
85 gal. S. S. Jacketed and Mixing Kettles.
Huhn Steam and Gas Fired Rotary Dryers.
Kent and Lehman 3 Roll Mills.
Allis Chalmers, Great Western Sifters.
J. H. Day 7' x 40" S. S. Single Deck Sifter.
Pony M, ML, Auto. Duplex Labelrites; World Rotary, Straightaway Labelers.
Pneumatic Scale Cartoning Line.
Miller, Scandia, Hayssen Wrappers.
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CLASSIFIERS: 6—Akins and Womco 54" and 78", single screw, double pitch, weir type, 220/440 volt motors, all in new condition. Three of the above located near Reno, Nevada. 2—Dorr 8' x 30' rake, one with 10' and one with 22' bowl. Now condition.

DRYERS or KILNS: 2—10 ft. x 90 ft., heavy duty, with or without auxiliary equipment, condition like NEW. One located in Minnesota. 1—Kiln 4 ft. dia. x 65 ft., complete with all equipment, oil fired, like NEW.

AIR SEPARATORS: 4 ft., 6 ft., 10 ft. and 16 ft. with motors and drive.

PULVERIZERS: Hardinge Mill size 5 ft. x 22", steel lined, complete with disc feeder and 30 H.P. motor. 1—10 ft. x 30" Hardinge Conical Ball Mill with 300 H.P. motor and all auxiliary equipment for dry grinding. 1—6' x 36", silica lined. 1—Sturtevant 1½ Ring Roll Mill. 1—3' x 4' Eimco Ball Mill complete with liners, ball charge, V-belt drive and 20 H.P. motor and control. NEW condition.

FEEDER: 1—Telsmith 40" x 10 ft. with steel skirts, Reeves drive and 15 H.P. motor and push button starter.

COMPRESSORS: Worthington DC2, 29/18-½ x 21, 600 H.P. synchronous motor, 440 volts, with all auxiliary equipment. 4—Ingersoll Rand diesel portable, 500 cu. ft. @ 100 lbs. pressure. NEW 1951.

DIESEL MOTOR: 122 H.P. Caterpillar D13000 complete with clutch, V-belt pulley and spare parts.

BOOT BUCKET ELEVATORS: All steel, fully enclosed, with 12" x 7" buckets on steel chain, 23 ft., 40 ft. and 46 ft. with motors, speed reducers, etc.

STEEL STORAGE TANK: 10 ft. dia., 10 ton capacity, circular storage bin with cone bottom and steel supports.

BRIQUETTING PRESS: 1—Komarek & Greaves 32" dia. rolls, 23/16" face, with 503 cups, 2-3/32 x 2-3/32".

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Stainless Steel Tanks, new, 100 and 200 gal.
2—300 gal. #316 Stainless Tanks—new.
1—Stainless Tank, No. 430 Chrome, vert. 7' dia., 10' deep, dished bottom, ¾ plate.
20—Steam Jacketed Kettles, Stainless Steel, Copper & Aluminum, 5 to 250 gals.
1—Copper Evaporator, steam jacketed, 9'1"x3'9".
60—New Pressure Cookers, 18"x18" & 24"x28".
50—Pumps—steam and electric.
1—New Glass Nash Centrifugal Pump, 100 gpm at 40'.
1—Buffovak Impregnating Tank, 42"x52" steam jacketed, used one week.

1—Ribbon type Mixer, steam jacketed.
1—Model 16 Sharples Stainless Steel Centrifuge.
3—New Drum Rollers.
1—A. F. Bartlett Hog Mill & 7½ H.P. Motor.
1—Sweetland Filter No. 5, 15 leaves.
3—Stainless Steel Jacketed Filters.
2—Plate & Frame Filters, 29"—open del.
4—Tanks, 100,000 gals. each.
1—Shriver 10" Aluminum Filter 9-plates 9-frames, closed delivery.
4—Stokes Rotary Tablet Machines RD4.
10—New Sharples Oil Purifiers.
6—New Cleveo Can Filling Machines.

SPECIAL—:—6—3000 gal. Steam Jacketed Kettles with Turbo Agitators.
1—3x4 Patterson Ball Mill, Manganese Lined, with motor.
1—24" x 10" Hardinge Conical Blender.

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MILLS, HARDINGE—7'x48", 5'x22", 10'x 36" w/motor drives.
PULVERIZERS, Raymond #1, w/separator/cyclone, Sturt. #1 Ring Roll, Wms. LG-25, GA-30, Prater 100 Blue Streak.
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CRUSHERS, JAW—6x9, 8x14, 14x26, 24x 36.
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TANK, 12,000 gal. Steel, 8'x32'.
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1—6' Raymond Whizzer separator.
1—4' x 8½', 3 deck, Robins "Gyrex" screen.
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Now dryers in stock.

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Cast Steel Rotor and Stator
Complete with motor. Used only a few hours.

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2—1500# hor. Dope Mixers, glass lined, dim. 11' x 5'.
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1—9'6" x 9'6" x 200'—¾" shell
1—8' x 135'—⅝" shell
1—8' x 115'—⅝" shell
1—8'6" x 100'—½" shell
1—10' x 90'—9/16" shell
1—9'6" x 83'—¾" shell
1—6' x 60'—¾" shell
1—Link Belt 11'6" x 35' Roto-Louvre
1—Link Belt 2'7" x 8' monel Roto-Louvre
6—Rotary Dryers 7' x 70', 7' x 60', 5' x 57", 4'6" x 40', 4'6" x 35', 4' x 20'
4—Louisville Rotary Steam Tube Dryers 8' x 50', 8' x 30', 4'6" x 25'
3—Buflovak 20, 15, 7 and 5 Shelf Vacuum Dryers 42" x 42"
5—Stokes & Buflovak Rotary Vacuum Dryers 30" x 8', 3' x 15', 6'6" x 38'
1—Blaw-Knox Stainless Steel Rotary Vac. Dryers 42" x 8'
1—Buflovak 32" x 100" Atmos. Double Drum
1—Single Drum 60" x 80" Flaker
1—14 Truck steam heated Dryer 1680 sq.ft.
3—Devine 17 shelf double door Vacuum Dryers 39" x 78"

FILTERS

6—Vallez Pressure Filters 360 and 540 sq. ft.
2—Sweetland #12 with 36 and 72 leaves
1—Sweetland #7 with 27 steel leaves
8—Oliver Rotary Vacuum 11'6" x 14', 8' x 12', 8' x 10', 8' x 8', 3' x 4', 3' x 1'
3—Eimco Rotary Vac. 6' x 8', 4' x 5', 4' x 4'
1—Oliver Rotary Vacuum Pressure Filter 3' x 4' steel
1—Oliver 8' x 8' Rotary Precoat Filter, rubber-lined
1—Feinc Rotary Vacuum 8' x 12'
2—42" P&F, 55 chambers, 2"
4—Shriver 36" P&F, 30 chambers
1—Sperry 36" Recessed, 48 chambers
5—Shriver 30" P&F, 30 chambers
8—Sperry 24" P&F, 16 chambers
1—Shriver 24" Recessed, 30 chambers
3—Shriver 18" Recessed, 30 chambers
2—Sperry Aluminum 30" and 24" P&F, 22 and 26 chambers
1—Shriver Aluminum 12" P&F, 8 chambers

CENTRIFUGALS

1—Bird 48" suspended steel
1—Tolhurst 48" Center Slung S.S.
1—AT&M 42" Suspended S.S.
8—AT&M 40" Bronze Baskets
1—Fletcher 40" Suspended, Bottom discharge, S.S. perforated basket
1—Tolhurst 32" Suspended Monel
1—AT&M 20" Rubber Covered
2—Bird 36"x36" solid bowl, stainless
1—Sharples P14 S.S. Super-D-Canter
4—Sharples #16 S.S. and steel

PULVERIZERS

1—Raymond 5 Roll High Side Mill
1—Bauer 36" Attrition Mill 2—50HP motor
17—Patterson, Abbe Pebble & Ball Mills 60 to 1000 gals.
2—Premier Colloid Mills 8" dia., S.S.
1—Eppenbach QV7 Colloid Mill
2—Jeffrey 36"x24", 20"x12" Hammer Mills
2—Raymond 8', 4' Air Separators
1—2 Roll Rubber Mill 6"x12"
1—5'x23' Tube Mill
2—Fitz Comminuting Mills 7½ HP

SCREENS

1—Selectro S.S. double deck 4'x10'
5—Sprout Waldron S.S. single deck, 40"x84"
1—Robinson Rotex Single Deck 40"x84", 40"x104"
1—Tyler Hummer 4'x7' Single Deck
5—Tyler Hummer 3'x5' Triple Deck
1—Abbe #2 Blutergess Sifter

MIXERS—ALL TYPES

7—Baker Perkins 200, 100, 20 and 9 gals., jacketed, double arm, sigma blades
1—Baker Perkins 300 gal. Unidor S.S.
1—Baker Perkins 2 gal. Stainless
1—Day 100 gal. Cincinnatus jktd. double arm
1—Day 30 gal. Imperial jktd. double arm
10—Day 200# to 3000# Powder Mixers
1—North 40 cu.ft. S.S. jacketed Powder Mixer
12—Electric Portable Agitators ¼ HP to 5 HP, NEW
4—Day, Ross, 8 and 50 gal. Pony Mixers
1—Eppenbach 1 HP Homo Mixer

MISCELLANEOUS

20—Bucket Elevators, steel housings, 34' to 90' centers, 8"x5" to 24"x8" buckets
7—Stokes Vacuum Pumps 15 to 100 CFM
1—Milton Roy Proportioneer Pump, S.S. and Hastelloy, 10 GPM
1—Oliver Horizontal Dry Vacuum Pump 400 CFM
5—Devine, Buflovak Condensers and Receivers, 20 to 90 sq.ft.
7—Groen 150, 125 gal. Stainless Steel, jacketed, agitated kettles
4—Stokes DD2, D4 Rotary Tablet Machines
5—38" dia. Stainless Steel Revolving Pans
1—Nash Hytor Vacuum Pump 180 CFM
10—Olivite Duriron & rubber Centrifugal Pumps, 1½" to 4"

1—8'6"x200', ¾" shell, Rotary Kiln
1—8'x135', ⅝" shell, Rotary Kiln
2—Oliver monel 8'x10' Rotary Vac. Filters
7—Rogers Spray Dryers 16' dia., with all accessories
4—Pfaudler 100 gal. glass-lined Stills with condensers receivers
4—Steel 2000 gal. jacketed, agitated, 200 psi Reactors
1—Pfaudler 350 gal. glass-lined, jktd, agitated Reactor
3—Dopp 250, 150 gal. jacketed, agitated kettles
1—North 40 cu.ft. S.S. jacketed Powder Mixer.
5—Steel Storage Pressure and Acid Vessels 3500 to 20,000 gals.
1—Quadruple Effect Evaporator, brass tubes 16,000 sq.ft.
1—Buflovak VRC, stainless steel Single Effect Evaporator 94 sq.ft.
1—Buflovak VRC, Triple Effect, 900 sq.ft.
1—Buflovak 6' dia. Vacuum Crystallizer
2—NEW Absorption Towers, 13,500 gal. cap.
10—Steel Tanks 9000 to 100,000 gals.
12—Tubular Condensers 200 to 1000 sq.ft.

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New Rotary Dryers, Kilns & Coolers built to order.
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1—Buffalo Vac Drum Dryer 24x20'". Also Rotary Vac. Dryers & Vac. Shelf Dryers.
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CENTRIFUGALS & CENTRIFUGES

5—Tolhurst 40" Suspended Type Centrifugals. Bottom Discharge. Motor Driven.
6—Centrifugals 20", 30", 40" & 48", Steel, Copper, Stainless & Rubber Lined.
12—Sharples Centrifuges 25A Stainless. Also #6.
3—De Laval Multiplate Clarifiers #200, 300 & 307.

FILTERS

1—Vallez 4' Stainless Covered Leaf Filter, type 45.
3—30" x 30" Corner Feed Iron Filter Presses.
10—Sperry & Shriver 7", 12", 18", 24", 30", 36", 42", Iron & Wood Filter Presses.
1—12" Bronze Filter Press.
Extra 36" & 40" iron plates & frames.
Sweetland & Oliver Rotary Vac. Filters.

KETTLES & TANKS

1—Steel ASME 275 PSI Pressure Tank. 1200 gals.
Divine 500 gal. closed jack agit. steel kettle.
8—Jacketed Kettles 50 to 1000 gals.
1—250 gal. Lead Lined Kettle.
1—1000 gal. Stainless Agitated Tank.
New Stainless Steel Tanks 50 to 500 gals.
30—Stainless Alum., Copper, Glass & Lead Lined Kettles & Tanks.
6—Copper Varnish Kettles 150, 200 & 300 gals.

PULVERIZERS & MILLS

1—#32 Raymond Pulverizer with 20 H.P. AC motor. Vac. Separator & Cyclone Collector.
1—Raymond #00 Pulverizer 30 HP. Complete.
4—#0000 Raymond Mills.
5—Hammer Mills & Pulverizers 3 to 50 H.P.
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1—Sturtevant 30" Rock Emery Mill.
1—Robinson 22" Attrition Mill.
1—Lehman 4 Roll W. C. 12" x 36" Steel Mill.
5—Lehman & Kent 3 Roll Steel Mills.
6"x22", 9"x32", 12"x36", 6"x40".
1—9" x 36" Double Steel Roller Mill.
1—9" x 24" 3 pr. high steel Roller Mills.
1—Hoschin 10" x 36", 4 Roll Granite Stone Mills.
2—Abbe Pebble Mills, 6'x8' & 36"x42".
8—Abbe Jar Mills Lab to 25 gal. sizes.
Ball & Jewell & Leominster Rotary Cutters.
1—U. S. Colloid Mill 1½ HP Motor.

MIXERS—ALL TYPES

Baker-Perkins heavy duty double arm Mixers, 200, 100, 50, 5 & 1½ gals.
Horiz. Mixers single & double arm to 200 gal.
Day & Ross 40 & 15 gal. Pony Mixers.
1—Century 2 HP, 4 speed Vert. Mixer.
6—Lead & Paste Mixers 50 to 150 gals.
Patterson 3½ dia. Stainless Conical Blender.
1—Master Drum Type Blender 1000#.
10—Dry Spiral Mixers 50 to 2000 lbs.
12—Portable Elec. Liquid Mixers ¼ to 3 HP.

SCREENS & SIFTERS

1—Jeffrey 1 deck 18" x 48" Conveyor Screen.
2—Gyratory suspended Sifters 20"x24".

MISC. & SPECIALS

4—200 Ton Brunswick 16" upstroke Record Presses.
1—French Oil Linseed & Cottonseed Hydr. Presses.
1—Goulds 75 HP, 2 stage motor driven Centrifugal Pump, 2500 WP.
1—French Oil Motor Driven Expellers.
New 6" x 12" Lab Mixing Mills & Calenders.
1—Farrel 15" x 36", 16" x 48" & up to 22" x 60" 2 Roll Mixing Mills.
3—Rubber & Plastic Extruders 1" to 6".
1—Stokes 2E Paste Filler up to 5 gal.
1—Marco #200 Stainless Steel Homogenizer.
1—Stokes & Smith & Day Powder Filters.
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Rotary & Single Punch Tablet Machines, ½" to 3".
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2—Revolving Pans 30" & 36".
4—Stokes Vert. High Vac. Pumps.
2—Worthington 12" x 12" x 12" Vac. Pumps.
6—Devine & Buffalo Vac. Pumps.
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Eimco 8'x8' Filter, cl. drum, agit. trough, Nash Vac Pump, blower, receiver, baromet leg, piping & all motors. 1946 model, condition like new
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Shriver Filter Press 30"x30" 29 plates 30 frames, washing type
Patterson Reactor with 4 speed Unidrive turbine agit. 3'x6'8", with coil & Sparger
Jay-Bee Hammermill with 10 HP motor
Abbe Lenart Mixer 300 Gal Cap'y, 30 HP
Charlotte 10" Colloid Mill with 30 HP
Moore 4'x5' Steel Ball Mill, 15 HP Grhd
2—Acme Vacuum Pans, copper, coil type, 1100 and 1500 Gals Cap'y.
Multiclone Dust Collecting System, with 15 HP suction blower
Sweetland #7 Filter, 41 leaves 2 Ctrs
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Autoclave: 10 gal. Buflovak, cast iron.
Vacuum Pan: 6' Harris stainless steel.
Vacuum Pumps: Stokes 105 CFM. 3 hp.
Powder Mixers: 100 to 2000 lb. capacities.
Pebble Mills: 200 gallon Patterson.
Starch Cookers: 300 gal. Lee stain. steel.
Colloid Mill: Premier 3" st. steel, 7½ hp.
Oil Purifier: De Laval No. 600.
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Mill: Hardinge 5' x 36" buhrstone lined.

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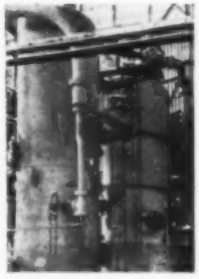

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STAINLESS — NICKEL — MONEL EQUIPMENT

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Zaremba Inconel Evaporator 7'x15½' with inconel tubes, 430 sq. ft. surface.
2 S/S Atmospheric Rotary Drum Dryers 5' x 10'.
1 Chrome Plated Rotary Drum Dryer 5' x 12'.
1 Squier S/S Rotary Atmospheric Dryer; 30" x 20'.
1 Monel Lined Louisville Conuter Current Dryer 38" x 16'.
1 Sharples S/S Super Centrifuge; Misco type.
4 A. T. & M. S/S 60" Link Belt Suspended Centrifugals with Vacuum tight covers.
1 Oliver Dorrco Type Rotary Vacuum Filter 6'x3'; Nickel contacts.
4 S/S Reactors or Vacuum Vessels from 80 gal. to 500 gal.
1 S/S Dopplop Jacketed Reactor 40" x 60".
1 Monel Vacuum Pressure Water Still; 50 GPH.
1 S/S Ball & Jewell No. 1½ Rotary Cutter; 40 HP.
Large Stock of S/S Jacketed Kettles and Tanks; all sizes.
Stainless Bucket Elevators, Moyno Pumps, Lab. Dryer, etc.

EQUIPMENT FABRICATED to your SPECIFICATIONS

FIRST MACHINERY CORP.

157 HUDSON ST. WOrth 4-5900 NEW YORK 13, N. Y.

FOR SALE

ONE ST. REGIS TYPE 301 FB VALVE BAG FILLING MACHINE

Equipped with guards, solenoid tripping device for cutoff valve. Machine approximately 15 months old and has had very little use. Original cost $27,750. If interested call or write Husky Oil Company attention of C. A. Colbern, Box 380, Cody, Wyoming, or telephone Cody, Wyoming, 500

EVAPORATOR

Double effect C. I. Vacuum Pans for evaporating solutions containing salts or sugar, equipped with 2"x4' copper tubes, copper flue sheets, bronze circulating propellers and four tanks for washing crystals, also vacuum pump and condenser. Reasonably priced.

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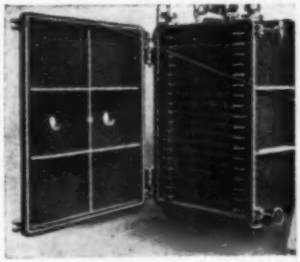

2 BUFLOVAK 20 SHELF Vacuum Chamber DRYERS Complete with accessories.

Stokes Cabinet Dryer; 16 shelf steam heated; 3' x 3'.

Rotary Drum Dryers by Devine, Buffalo, Struthers-Wells, Adt, etc., in stainless, nickel, bronze, iron; 2' x 15'; 4' x 4'; 4' x 8'; 5' x 10'.

Bagley & Sewell Double Drum Dryer in iron, 28" x 5', others.

Proctor & Schwartz Continuous Apron Conveyor Type Dryer, 44' long.

Buffalo Rotary Vacuum Drum Dryer, 5' x 12'; and others.

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157 Hudson Street,
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FILTER PRESSES

1—Shriver 7" Filter Press—6 Plates 7 Frames—½" Frames

1—12"x12" Filter Press—10 Plates 11 Frames—Washing Type

1—Shriver 18"x18" Filter Press—11 Plates —13 Frames

1—Sperry 24"x24" Filter Press—10 Plates —15 Frames—Closed Delivery—Washing Type—Lith Coated

1—Sperry 24"x24" Filter Press—17 Frames —18 Plates—Flush Thorough Washing —Lith Coated Rachet Closure—Like New

1—Johnson 30"x30" Filter Press—32 Plates —33 Frames—Open Delivery

1—ERTAL FILTER PRESS—12" DIAMETER HARD RUBBER PLATES—20 PLATES CLOSED DELIVERY

AARON Equipment Company
1347 So. Ashland Ave., Chicago 8, Illinois
PHONE: CHesapeake 3-5360

FOR SALE

2 Paul Abbe #6 Pebble Mills, porcelain lined, 32"x36".
1 Hardinge Conical Ball Mill, Steel Liner, 4'8" dia. x 24" long.
3 Sprout Waldron Attrition Mills, double disc—sizes 18 and 36.
1 Williams Hammer Mill, type AK; size A, stainless steel.
1 Mikro Pulverizer—#2-SI.
1 Fitzpatrick Model "D" Comminuting Machine, Stainless Steel.
1 Illinois Water Treating System, 500 GPH flow rate, complete with Zeolite tank, controls, etc.

1 Swenson Rotary Continuous Vacuum Filter; Precoat type, 8' dia. x 8' face, rubber covered and lead acid proof construction.
1 FEINC Rotary Vacuum Filter, string discharge, 4'6" dia. x 6' face, aluminum.

1 Alsop SD-12-NR-30 Filter T 316 St. St.
1 INDUSTRIAL FILTER & PUMP MFG. CO. Pressure filters, type RB, size 10x48, 68 sq. ft.; rubber lined tank, bronze leaves.
3 Sweetland Filters—#2, #5 & #12.
10 Filter Presses, Cast Iron:
1 Sperry 36", 24 ch., open delv. wash.
1 Shriver 20", 35 rec. pl., open delv.
1 Shriver 24", 40 ch., open delv. wash.
1 Shriver 24", 24 ch., closed delv.
1 Sperry 24", 15 rec. pl., open delv.
2 Johnson 18", 6 ch., closed delv.
2 Sperry 10", 1 ch., closed delv.
2 Louisville 6-roll Continuous Grains Presses, 24" and 38" wide.
1 Louisville Rotary Steam Tube Dryer, 5' dia. x 20'6" long, with screw press.
1 Pan Dryer or crystallizing Kettle, 10' dia. x 3' deep.
1 Stokes #39A Jacketed Vacuum Rotary Dryer, 18" dia. x 42" long, with pump and condenser.
2 Atm. Double Drum Dryers, 22"x36".
1 Cummer Rotary Hot Air Dryer, 4' dia. x 28' long.

STAINLESS STEEL TANKS
IN STOCK

2—16,200 gal. Vert., closed, T304—NEW.
1—5700 gal. Horiz., T304—NEW
1—5700 gal. Horiz., T302—NEW
1—4200 gal. Vert., closed, T304—NEW.
1—2350 gal. Vert., open, T302—NEW
1—1400 gal. Vert., open, 10'L x 57"W x 57"D
4—1000 gal. Vert., T304—NEW
4— 500 gal. Vert., T304—NEW
50—Stainless Steel Tanks—from 6 gal. to 450 gal. sizes.

6—3000 gal. Horizontal Stainless Steel Tanks, 5'4" dia. x 18'9" long, insulated and agitated. Excellent for transporting, storage or holding.

1 Porter heavy duty jacketed double worm mixer—75 gal.
1 Broughton Powder Mixer, double arm, 50 cu. ft.
10 Copper Conical Blenders, ½, 1, 7 & 11 cu. ft.
3 Selectro Vibrating Screens, stainless steel, 2' x 7', double deck, enclosed.

5 Aluminum Tanks, closed, 500, 1350, 1485 and 43,400 gal.

2 Kux Mach. Co. Model 25 Rotary Pellet Presses, 21 & 25 punch—with motor and vari-drive.
6 Stokes Rotary Pellet Presses, 16 punch —B-2, D-3, D-4.
1 Paterson 12 gal. Inconel Pilot Plant Kettle, Jktd. & Agit. with Dowtherm unit.
1 Stainless Steel, type 347 Autoclave or pressure tank; 250# pr., Elec. heated 850° F; 17¼" dia. x 9' high.
70 Stainless Steel and Stainless Clad open top, steam jacketed kettles—10, 40, 60, 80, 100, 150, 250, 500 gal. sizes.
1 Stainless Steel Kettle, 850 gal., 28# jkt. pr., vertical agitator, Type 347 shell, belted C.I. top.
1 3000 gal. Horiz. Steel Cooker, Vacuum, Agitated.
1 Lead Lined Kettle, 500 gal., closed top, with coils, jacket & agitator.
1 Aluminum 100 gal. Reaction Kettle, Jktd. & Agit.
1 Glass Lined Kettle, Jktd. & Agit. 50 gal.
22 Horizontal welded steel tanks brewery glass lined, 15190 gal.

5—Vertical Jacketed Pressure Tanks—steel—30# steam jacket—6mm vacuum internally:
3—34" ID x 15' H (approx. 700 gal.)
1—23" ID x 10' H (approx. 230 gal.)
1—23" ID x .9' H (approx. 195 gal.)

1 Bird Suspended 48" steel centrifugal Perf. basket.
2 DeLaval #600 Oil Purifiers.
2 Copper Vacuum Kettles, 48" dia. jacketed, agitated.
1 Copper Vacuum Evaporating Pan, 6' dia.—jacketed and coils.
1 Struthers Wells Evaporator, 100 sq. ft. tube bundle.
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2 Ingersoll Rand Type FB-538 Motor blowers 4000 CFM at 3 lb. pr.
1 Byron Jackson Deep Well Pump, 150 GPM 325' head, NEW.
1 Ingersoll Rand Bronze Centrifugal Pump #5ALV, 40 HP motor, 850 GPM at 140' —NEW.
2 Ingersoll Rand Bronze Centrifugal Pumps, #1½-RVH, 20 HP motor, 200 GPM at 230'.
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Stainless Steel: 39 sq. ft.
Aluminum: 186 sq. ft.
Copper: 75, 95, 340, 423, 487 sq. ft. sq. ft.
5 Stainless Steel Coil Condensers, 40 sq.ft.
4 Copper Beer Still Columns, 24" dia. to 60" dia.
5 Copper Bubble Cap Columns, 18" dia. to 78" dia.
3 Aluminum Bubble Cap Columns, 27" dia. x 18 plate & 36" dia. x 45 plate.
1 Aluminum Perforated Column, 28" dia. x 30 plate.
1 Steel and Cast Iron Bubble Cap Column, 30" dia. x 62 plate.

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We have in stock a quantity of Stainless Steel sheets: Type 304—12 ga., 14 ga. and 16 ga. Tanks, receivers, etc. fabricated to your specifications.

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Crushing • Grinding • Sifting

International 8' x 8' Porcelain Lined Pebble Mills with 50 HP Gear-Motors.

Abbe 4½' x 5' Belgian Block Lined Pebble Mills; pulley driven.

Abbe 5' x 6' Buhrstone Lined Mills.

5 Williams Heavy Duty Hammer Mills No. 3 and 4 50/65 HP.
3 Mikro Pulverizers No. 1, 2 and 4.
2 Gruendler Mills No. 3 and No. 12 to 75 HP.
1 Gump "Bar-Nun" No. 40 Hammer Mill 75 HP.
Raymond Imp Mill and No. "00" Pulverizer.
Bell & Jewel No. 1½ Stainless Rotary Cutter with 40 HP.
2 Sprout Waldron Saw Tooth Crushers; 16"x16" and 20"x25".
1 American Pulverizer, Ring Roll Crusher 50 HP.
1 Sturtevant Jaw Crusher; 8"x10".

1 Stainless Steel Saw Tooth Rotary Crusher; 2 Rotors 10"; 2 HP.
Large quantity of REDLER Conveyors; installations available for moving powder and granular materials in any direction at any speed.
2 Steel Cased Bucket Elevators up to 40' high; adaptable to your needs.
Ribbon Type Dry Powder Mixers in steel and stainless up to 3,000 lbs.
Rotex and Bo-Ball Sifters; 20"x48"; 40"x80" and 40"x120".

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1—New Telhurst 48" Stainless Steel Center Slung Centrifuge
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1—Stokes "DDS-2" Rotary Press, M.D.
2—Stokes "B-2" Rotary Presses, M.D.
1—Shriver 30" C.I. Filter Press 36 Ch.
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10—Stainless Steel Agitated & Jacketed Kettles, 100, 125, 950 gals.
10—Stainless Steel Tanks 200 to 1000 Gals.
3—Aluminum Tanks 1500 Gals. Closed
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3—Rotex Screens 40" x 84" to 40" x 120"
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1—Mikro #2FF Pulverizer, S.S. & Brss. Const.
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VARNISH TANKS—USED—64" diameter x 14'6" high (or long) ¼" Steel — Welded construction — 1700 gallons.

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Pumps only or completely assembled on bases

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Worthite	Cast Iron	Bronze
26—¾"	15—1"	2—1"
5—1"	32—1¼"	2—1½"
3—1½"	21—2"	2—2"
7—2"	9—2½"	
10—3"	2—4"	

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1/6 HP thru 75 HP - Dripproof totally enclosed - explosion proof

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Mikro Pulverizer #3 & #4 With AC Motors
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3 Bird-Young Continuous Vac. Filters 3' x 10' Free Rubber Covered, Complete Units, 1 new—2 Used 90 Days.

New S.S. Or Steel Ribbon Blenders From 12 to 100 Cu. Ft.,

Also Rebuilt Units Available.

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14 tanks 25' dia. x 16' high (59,000 gal. cap.)
4 tanks 20' dia. x 16' high (38,000 gal. cap.)
12 tanks 16' dia. x 16' high (24,000 gal. cap.)
1 tank 14' dia. x 7' high (8,000 gal. cap.)
1 tank 10' dia. x 16' high (10,000 gal. cap.)
2 tanks 9' dia. x 10' 6" high (5,000 gal. cap.)

(ALSO AVAILABLE: 12 Rotary Agitators for Wood or Steel Tanks. Will fit tanks up to 25' dia. 16' high.)

Excellent Condition

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Constructed of Long Leaf Yellow Pine

Suitable for Chemicals, Acids, and most any type of Liquid or Bulk Storage

1" Steel Rods around circumference

Easily dismantled and reassembled

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MIXERS of All Types

100 gal. working capacity, W. & P. type; heavy duty; Jktd. Double Arm; geared both sides.

Lancaster Model EAG4, muller type Mixer with accessories.

Double Ribbon Powder Mixers in stainless steel and steel; sizes from 200 lb. to 3,000 lbs.

Paste Mixers and Lead Mixers.

Mixing Tanks and Reactors in all metals and capacities.

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1—Eppenbach Stainless Steel Homo Mixer, complete with a 7½ HP Explosion-Proof Motor.
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1—J. H. Day #2, 75 Gal. Brighton Mixer.
3—Pebble Mills 40 to 500 Gal.
10—Pony Mixers, 8, 15 and 40 Gal.
HIGH SPEED Roller Mills 9"x24" to 16"x40".
1—Motor Driven Belt Conveyor.
3—20" Premier Colloid Mills, watercooled.
2—#281 Mikro-Pulverizers with 10 hp Motors.

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TIME-SAVING TIPS *IN CHEMICAL EQUIPMENT*

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5'x47'x¼" Absorption, ASME, 20 trays (2).
5'x38'x⅜" Absorption, ASME, 14 trays.
3'6"x58'x⅜" Absorption.
8'x36'x⅜" Absorption (2-UNUSED).
11'6"x58'x⅜" Absorption.
6'x44'x21/16" Scrubber, 5" heads, 225 PSI.
6'x49'x⅜" Bubble Cap, 19 trays.
6'x29'8" Bubble Cap, SS, 21 trays.

COMPRESSORS
Fuller C-11, 31 to 32 CFM.
Fuller C-80, 385 to 405 CFM.
Worthington, 275 CFM, 30 PSI, (2).
Brunswick, refrigeration, 5½"x15", M.D.

CONDENSERS - HEAT EXCHANGERS
Al. Chol. 400 sq. ft. Admiralty tubes (NEW).
Wheeler 3,640 sq. ft. Admiralty tubes (NEW).
Braun, 1035 sq. ft. 250 PSI W.P. (2).
Whitlock, vert., 3463 sq. ft., steel. (4).

CRUSHERS
Fairfield, 24"x24", single roll.
Two-Roll Traylor, 40"x14".
Traylor, Bulldog, Jaw, 18"x36".
Bartlett & Snow, spiked, 15"x16".
Sturtevant Mill, roll, 12"x12".

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Tunnel Truck 9'x35'x9', cap. 14 trucks, comp.
Turbulaire N2 Spray, with filter.
Stokes, Rotary, Vacuum, 30"x8', Complete.
Buflovak 5'x6' Atmos. single drum.
Stokes, 4'x9' Atmos. double drum.

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Syntron, vibra-flow, type F350.
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Allis-Chalmers electro magnetic, "Utah."
Fuller 8", star type (2 NEW).
Fuller 12"x13" rectangular.
Tyler-Hummer 4'x7' Vibrating Screen.
Coombs Gyratory Sifters, 20" & 24". (4).

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2500 gal. ASME, jack'td., agit., steel.
400 gal. Pfaudler, glass-lined, jack'td., agit.
300 gal. Pfaudler, glass-lined, agit.
40 gal. SS clad, 40 PSI, jack'td. (6)
Pfaudler 60" jack'td. evaporating dishes. (2)

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36" Shriver Press, washing, closed delivery, Celeron plates & frames.
36" open, 27 chambers, wood plates.
8'x12' Feinc, all steel.
8'x10' Oliver, wood & steel (3).
11'6"x18' Oliver, all steel.
4'x5' Oliver, SS & wood (2).
#7 Sweetland, 2" spacing, 28 leaves avail.

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100M C.F., two lift. (2).

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7'x60'x⅜" with lifters.
6'x14'x9/16" Struthers-Wells (NEW).
5'x67'x5/16" with lifters.
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25"x15'x⅜".
9'6"x85'x⅜".
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9'6"x8'6"x200'x⅜".
24"x24' Sinclo Cooler.

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Paddle, 19"x24"x18", complete w/drive.
Paddle, double shaft, 140 cu. ft. (NEW).
Readco 1½ SA, 88 gals.
Blystone, 48"x67", 500 gals. (2).
Binks, type TM60, 100 gals. (2).
Champion, type E, size 2, 110 gals.
Ajax, #3 Super, 173 gals.
Sublimator, hor., 4'x10'.

PRESSURE VESSELS
8,200 gal. 6'x40'x2", 390 PSI.
3,500 gal. 5'x23'x½", 200 PSI (4).
2,000 gal. 5'x13'7½", 106 PSI.
1,250 gal. 4'x14', 106 PSI.
1,200 gal. 42"x16'8"x5/16", 125 PSI.
1,050 gal. 4'x12'x½", 106 PSI.

TANKS
25,000 gal. 10'x40'x⅜" (2—NEW).
12,000 gal. 8'x32'x¼", (2—NEW).
8,500 gal. vert. 8'x23'x5/16" (NEW).
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1,600 gal. 8'x7'x3/16" (2).
370 gal. 3'x7'x9/16".
6,500 gal. Tank Car Tanks.

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Nash H8. (2). Nash H7.

WEIGHING MACHINES
Weightometer, 20 ton, 18"x8'6".
Automatic, model NP, ¼ oz. to 3 lbs.

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CONDENSER—Scraper—8'x15', aluminum.
KETTLES—40 gal. SS, jack'd, 40# (6).
PUMPS—All sizes & capacities.
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TABLET PRESSES—Colton.
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Consists of: 2 - 7'9"x19'9"x½" refractory lined, direct fired vessels; 4 - 3460 sq. ft. heat exchangers; 1 - 5'x42'x½" packed tower; 1 - I.R. 375 GPM, 175' head centrifugal pump; 2 - Roots-Connersville 14"x18" type HD blowers, 1550 CFM, 6 PSI, 375 RPM.

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BOILERS
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3—70" x 35' Ruggles Coles A-18.
Single Shell: 4x30, 4x45, 5x30, 6x35, 5½x7x80.

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Hammermills: Jeffrey 36 x 24 B & 42 x 80 Pinetooth-Williams 80 OA.
Dings 60"—S Roll Type I.R. Magnetic Separator.
8', 10' & 16' Mechanical Air Separators
5 x 6, 6 x 6, 6 x 10 & 7 x 16 Ball Mills
#0 & #1 Raymond Automatic Pulverizer
4x45, 6x80, 5½x7x80 & 8x60 Rotary Kilns
9—3' x 22' Silex Lined Tube Mills
8½'-10-8½' x 80' Nodulizing Kiln
10' x36' Hardinge Air Classifying Ball Mill
3—5 x 18 Tube Mills
Heavy Media Separation Unit
Hercules Junior 3 Roll Pulverizer
Clyde-Kuntz Continuous Hydrator
7 Elec. Air Compressors, 1200, 2100 & 8374 Ft.
125—6000 & 10,000 Gal. Tank Cars
45 Ton Plymouth Diesel Locomotive
2450 ft. Cage Pipes. Elec. Compressor

STANHOPE, 80 E. 42nd St., N. Y. 17, N. Y.

FOR SALE
3—32"x90" Buflovak Double Drum Dryers.
100 to 250 gal. S.S. Mix Tanks, water jkt.
3000 gal. S.S. Truck Tanks, Trailerized.
100 gal. S.S. Clad Jkt. Kettles, 30"x32".
150 gal. S.S. Jkt. Kettle, 42"x34", agit.
Copper Still 44"x32", coil condenser.
300 gal. Pfaudler Horiz. Glass Line Tank, 25#.
4—60 gal. Steel Kettles, 75# jkt., A.S.M.E.
Premier Colloid Mill 6", 7½ H.P. motor.
Groendler Jr. Pulverizer, 10 H.P.
75 to 1000 gal. Homogenizers or Vissellizers.
20" Centrifugal Extractors, copper baskets.
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Model 140C Stokes High Vacuum Pump, 1½ H.P.
2" S.S. Centrifugal Pump, 5 H.P.
15 H.P. Lookout Vert. Tubular Boiler.
7 H.P. McKee Gas Fired Boiler.

Send us your inquiries

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596CFM—100#—100HP

Model 420 Base Mounted with 100 HP—G.E. Tri/Clad 2/60/220/440 built-in motors. Complete with self-contained cooling system.

—No Foundation Required

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DAY MOGUL MIXER

100—Gal.—Type MDC—Class 6 Jacketed Tank

FINE CONDITION

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Process Machinery including Vacuum Dryers, Heavy Duty Mixers, Reaction Kettles, Columns, Rotary Filters, Filter Presses, Pulverizers, Packaging and Wrapping equipment, S/S and non-corrosive Storage Tankage.

Will consider set up plant now operating or shut down. When offering give full particulars.

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L.W.BAUER

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FOR QUALITY AND VALUE

THE GELB GIRL—APRIL 1952

- 1—Sharples Stainless Steel Super D Canter #PN-14.
- 1—Kaven Stainless Steel Mixing Tank, 1000 gals. with Nettco WT-37 Drive, 20 HP Explosion Proof Motor and Turbine Type Agitator.
- 1—Feinc Stainless Steel Filter, 3' x 2'.
- 1—Niagara #200 Filter, Stainless Steel Leaves.
- 1—Shriver 42" Wood Plate & Frame Filter Press, Closed Delivery, 3 Eye, 38 Chambers.

- 1—Blaw Knox Steel Jacketed Autoclave, 6' x 13'.
- 1—Blaw Knox Autoclave, 2 Gals. Cap., with Anchor Type Agitator.
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- 2—Mikro Stainless Steel Atomizers, #5 & #6.
- 1—Proudler Glass Lined Condenser, 12 sq. ft.
- 1—Fuller Model C-200 Compressor.
- 1—Nash Compressor, Model #H-7 with 150 HP Motor.
- 3—A. T. & M. Stainless Steel Centrifuges, Suspended Type, 48" x 54".
- 1—Fletcher Underslung Centrifuge, 20" steel Imperforated Basket.
- 1—Tolhurst Stainless Steel Suspended Type Centrifuge, 40" Imperforated Basket.
- 1—Fitzpatrick Model D Comminuting Machine, Stainless Steel & Bronze Construction.
- 1—Buflovak Double Drum Dryer, 24" x 36".
- 1—Buflovak Double Drum Dryer, 32" x 90".
- 2—J. P. Devine Vacuum Shelf Dryers, 5 & 9 Shelves.
- 1—J. P. Devine Vacuum Drum Dryer, 5' x 25'.
- 1—Louisville Rotary Steam Tube Dryer, 6' x 50'.
- 1—Ruggles Cole Rotary Kiln, 7½' x 60'.
- 2—Downington Stainless Steel Heat Exchangers, 500 sq. ft. each.
- 3—Sweetland Filters #2, 5 & 7.
- 1—Shriver 24" x 24" Cast Iron Filter Press, 30 Chambers, Open Delivery, Washing Type.
- 2—Shriver 36" x 36" Cast Iron Plate & Frame Filter Presses, 25 Chambers, Closed Delivery, Side Feed.
- 1—Shriver 36" x 36" Cast Iron Plate & Frame Filter Press, 49 Chambers, Closed Delivery, Steam Jacketed.
- 1—Shriver 24" x 24" Stainless Steel Jacketed Filter Press, 10 Chambers, Closed Delivery, 4 Eye, Washing Type.
- 2—Shriver 36" x 36" Cast Iron Plate & Frame Filter Presses, 24 Chambers, Open Delivery, Washing Type
- 1—Shriver 42" x 42" Evedur Plate & Frame Filter Press, 40 Chambers, Closed Delivery.
- 1—Sperry Heresite 36" x 36" Filter Press, 17 Chambers, 4 Eye, Closed Delivery.
- 1—Sperry 24" x 24" Aluminum Plate & Frame Filter Press, 22 Chambers, Open Delivery.

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- 1—Readco Stainless Steel Jacketed Double Arm Mixer, Sigma Blades, 225 gals. cap.
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- 4—Turbo Steel Jacketed Mixers, 700 gals. each.
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- 1—Stainless Steel Jacketed Vacuum Reactor, 500 gals. cap., with agitator.

- 1—Sperry 42" x 42" Cast Iron Plate & Frame Filter Press, 18 Chambers, Closed Delivery.
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- 1—Nickel Jacketed Kettle, 10 gals. cap.
- 1—Nickel Jacketed Kettle, 500 gals. cap.
- 1—Evedur Vacuum Kettle, 2,000 gals. cap.
- 2—J. P. Devine Steel Jacketed Vacuum Kettles, 2,000 gals. cap. ea.
- 1—Nickel Jacketed Vacuum Kettle, 400 gals. cap.
- 20—Stainless Steel Jacketed Kettles, 380 gals. cap. each.
- 1—Stainless Steel Jacketed Vacuum Reactor, 58 gals. cap.
- 2—Groen Stainless Steel Jacketed Kettles, 20 & 50 gals. cap.
- 1—Stainless Steel High Pressure Hydrogenator, 360 gals. cap., Working Pressure 250 PSI.
- 3—Steel Tanks, 1000 gals. cap. each, 125 PSI.
- 9—Steel Tanks, 8000 gals. cap. each, 125 PSI.
- 1—Steel Tank, 10,000 gals. cap., 125 PSI.
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R. GELB & SONS, Inc.,

CHEMICAL, RUBBER, OIL, PLASTIC and FOOD PROCESSING MACHINERY

STATE HIGHWAY No. 29, UNION, N. J. · UNionville 2-4900

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We're all in the steel business!

FOR EACH OF US TO *GET* MORE STEEL . . . AND PRODUCTS MADE OF STEEL . . .
WE'VE GOT TO *PROVIDE* MORE SCRAP TO *MAKE* THE STEEL.

Half the melting stock used in the steel mill or iron foundry consists of iron and steel scrap. In normal times, enough scrap is produced by the mills, foundries, railroads, fabricators and scrap dealers to fill the need.

But now the mills have stepped up capacity to meet the greatly increased military and civilian demands for steel. And that increased capacity has outstepped the supply of scrap.

That is why we are calling on plants in both metal-working and NON-METAL-WORKING industries to provide the needed scrap NOW.

You have the heavy scrap needed to make more steel

Enough obsolete machinery, equipment and parts are being carried as useless inventory to give a big push to the production of steel. Surveys have proved this.

The trick is to get that old steel into the hands of the steel producers.

We're putting that job up to you.

To help maintain steel production?.. provide more steel for the equipment you want . . . turn in your idle iron and steel to your local scrap dealer.

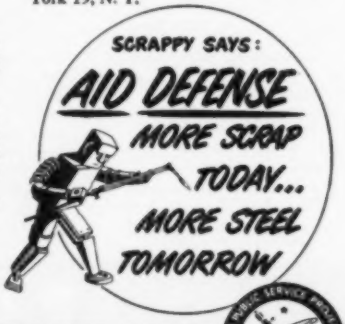
What you can do to help maintain steel production

1. Appoint one top official in your plant to take full responsibility for surveying the plant and getting out the scrap.

2. Consult with your local Scrap Mobilization Committee about its program to help out in the scrap crisis. For chairman's name, check with your Chamber of Commerce, or the nearest office of the National Production Authority, Department of Commerce.

3. Call in your local scrap dealer to help you work out a practical scrapping program. Non-ferrous scrap is needed, too.

4. Write for free booklet, "Top Management: Your Program For Emergency Scrap Recovery", addressing Advertising Council, 25 W. 45 St., New York 19, N. Y.



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● This film manufacturer was having trouble. In spite of precautions, every so often the sensitivity of his film would go haywire. Oddly, this happened only when the wind blew from the South, indicating that the cause of the trouble was due to some undetectable impurity in the outdoor air supplied by the air conditioning system.

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Let us send you full information about Dorex Air Recovery and how it might be applied to your air conditioning system. No obligation, of course.

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Air Diffusion • Air Purification • Air Recovery
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190 Murray Street, Montreal 3, P. Q.

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This new 800-page Quality Control Handbook helps you

ACHIEVE BETTER PRODUCT QUALITY AT LOWER COST

HERE is a reference of industrial know-how on the fundamentals and means of **achieving better quality at lower costs.** This handbook tells the whole story of quality control, in a comprehensive easy-reference form. It gives authoritative answers to questions on every phase of planning or carrying out a quality-control program. It provides a review of every phase, not merely the statistical, in the quality-control function. It gives you quick access to the many formulas, data, record forms, and other practical information needed in your work. In short, it is all the title **Quality-Control Handbook** implies — making available a wealth of facts and procedures in one well-organized volume.

QUALITY-CONTROL HANDBOOK

Edited by J. M. JURAN
McGraw-Hill Industrial Organization and Management Series
800 pages, 244 illus., 92 tables and charts, $10.00

THE first handbook in the field of quality control, this book thoroughly covers the principles and practices that aid you in achieving and maintaining better product quality at lower cost. It supplies executives, supervisors, and engineers in industry with the constantly-needed specific and general information needed in their day's work.

Prepared by J. M. Juran, and 9 other specialists in quality-control.

J. M. Juran is consultant on quality-control to leading industrial companies, Professor of Industrial Management at N.Y.U., and author and lecturer both here and abroad.

Fifteen big sections not only cover the economics of quality control but also explain how to organize for quality; how to gain acceptance, control, and assurance of quality; and similar aspects. Applications to specific processes and products, such as chemical, textile, and aircraft, are shown. Thoroughly covered are the statistical methods used in quality control and the paper work and record-keeping necessary.

Check this list for some of the specific topics covered:

- specification for quality
- organizing for quality
- efficient methods for getting paper work done
- ways of applying accounting machines to quality problems
- quality control in basic steel
- and others

The work of many specialists, this handbook contains page after page of illustrative examples and records, so that it brings the reader the broadest sort of perspective on the quality function, as well as practical information about what is being done with quality control today.

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330 W. 42nd St., NYC 18

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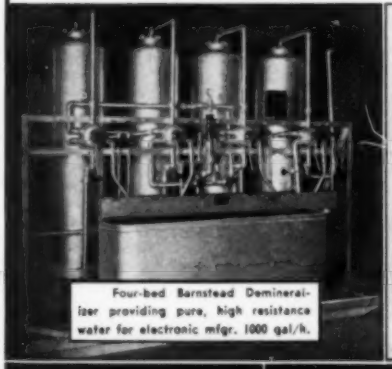
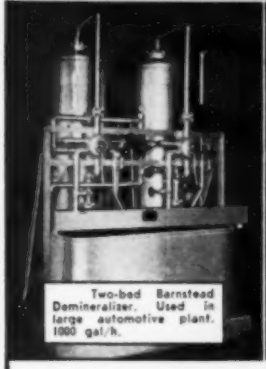


Four-bed Barnstead Demineralizer providing pure, high resistance water for electronic mfgr. 1000 gal/h.

Barnstead Four-Bed Demineralizer provides pure water for hot seal tank in anodizing. 30 gal/h.



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Selection of the best size and type of demineralizer for your operation depends on the nature of your raw water supply, flow rate needed, daily demand, and degree of purity required. Send a sample of your water to our Laboratory and Barnstead Engineers will perform the necessary analysis without obligation.

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STILL & STERILIZER CO.
4 Lanesville Terrace, Forest Hills, Boston 31, Mass.

"VARIETY is the spice of life"— and it's variety that makes Powell Valves the answer to all your flow control problems

Fig. 1847—Small 200-pound Swing Check Valve with screwed-in cap and regrindable, renewable disc. Available in a wide variety of corrosion-resisting metals and alloys.

Because they are made in such a wide variety of designs and materials, Powell Valves are the answer to the many flow control problems encountered in the Chemicals and Process Industries.

Whether it's to replace an unsatisfactory valve or for a new installation, Powell can supply a valve that's precisely adapted to the conditions under which it must operate.

The Wm. Powell Company, Cincinnati 22, Ohio

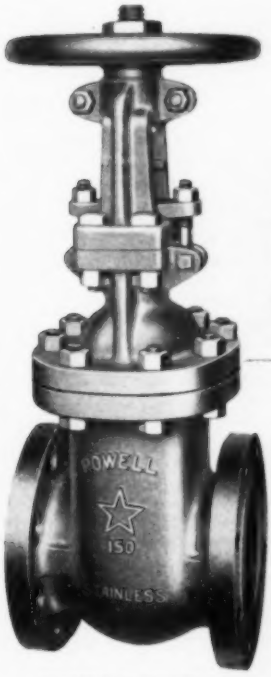


Fig. 1503 S. S.—Class 150-pound Stainless Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

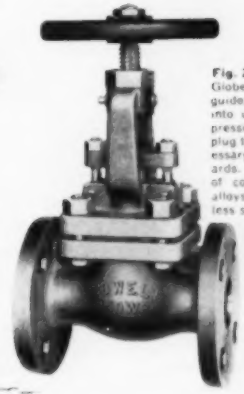


Fig. 2475—150-pound O. S. & Y. Globe Valve. Stem is threaded and guided through a bushing screwed into upper yoke which has a compression lubricant fitting. Seat and plug type disc easily reground if necessary. Conforms to latest standards. Available in a large selection of corrosion-resisting metals and alloys, with bolts and nuts in stainless steel. Also with screwed ends.

DEPENDABLE VALVES SINCE 1846

Fig. 2608—200-pound Bronze Globe Throttling Valve. A Powell design that permits FULL FLOW through seat when wide open, thus greatly minimizing turbulence and pressure drop. Has special bronze stem and stainless steel disc and seat hardened to approximately 500 Brinell.

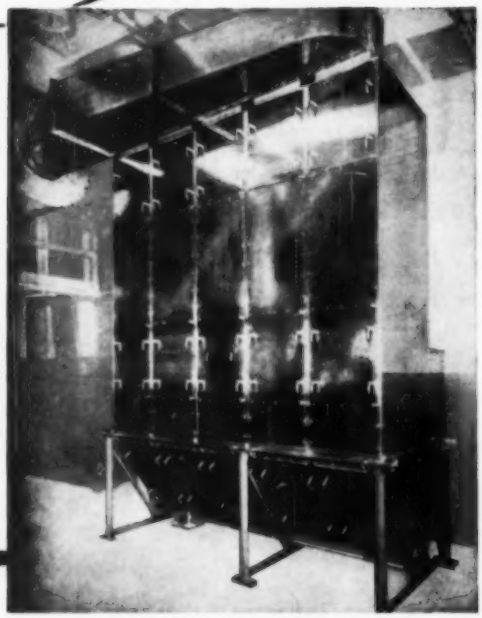
Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", incl. Has flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge. Also available in All Iron.

POWELL VALVES

In Bronze, Iron, Steel and Corrosion-Resisting Metals and Alloys.

$ave $ out of DU$T

$AVE DOLLAR$ OUT OF DU$T
In Processing of
FERTILIZERS
PLASTICS
DRUGS & COSMETICS
FOOD MATERIALS & OTHER PRODUCTS



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U. S. Design and Manufacture by
ENTOLETER DIVISION

Dust problems are effectively solved with the Simon Suction Filter Dust Collector. This self-contained, all-metal unit needs no accessory equipment except a fan and connecting ducts. Dust is collected at practically 100% efficiency, permitting air to be blown out of the chemical plant without costly loss of materials, or into the building without risk of dusty atmosphere. Cleaned air from collector can be returned to plants to save heat in winter, and blown outside in summer to control humidity • Streamlined ALL METAL design with minimum ledges and dead spots • Minimum maintenance cost • Low power — 1-HP to operate 12-section unit • Operates under suction, eliminating dust leaks. Send for complete information. ENTOLETER DIVISION, The Safety Car Heating and Lighting Co., Inc., 1197 Dixwell Ave., New Haven 4, Connecticut.

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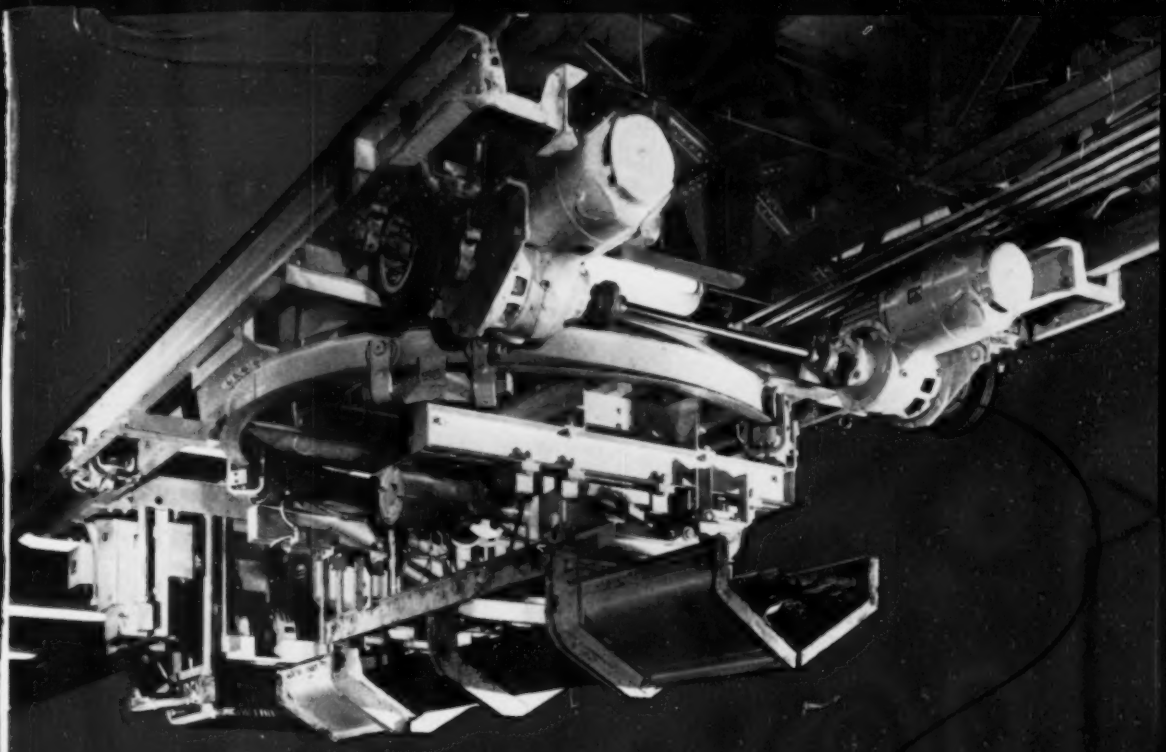

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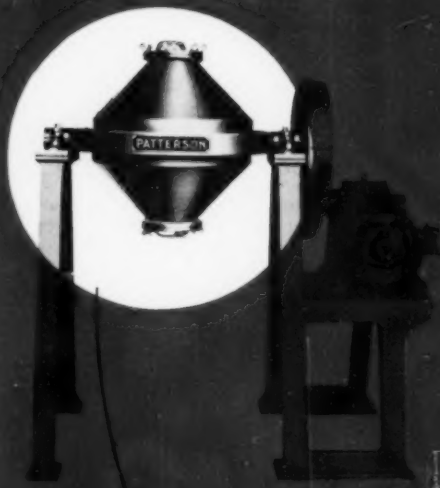

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